

High Octane

BEST 2009 Design Contest

Game Floor Drawing Package

Version 2.1

August 27, 2009



Boosting Engineering, Science & Technology™

**BEST Game Floor Drawing Package
doc# Revision 2.1; August 09**

dwg/part #	Title	Location
2009Top-00	Game Floor Assembly	In this packet
2009Top-10	Floor Assembly Instructions	Separate document
2009Top-20	Floor Build Tips and Guide	In this packet
2009Top-30	Master Bill of Materials	Separate document
2009Top-40		
2009Top-50	Implementing ECOs	Separate document
2009Top-60	Field Software Instructions	Separate document
2009Top-70	Testing and Troubleshooting	Separate document
2009Top-80	Contingency Floor Operation	Separate document
2009Top-90	Revision History	In this packet
2009EGS-00	EGS Assembly	In this packet
2009EGS-10	EGS Leg Assembly	In this packet
2009EGS-20	EGS Upper Deck	In this packet
2009EGS-30	EGS Lower Deck	In this packet
2009EGS-40	EGS Carousel	In this packet
2009EGS-50	EGS Chute	In this packet
2009EGS-60	EGS Actuator	In this packet
2009EGS-70	EGS Tower	In this packet
2009EGS-80	EGS Base	In this packet
2009EGS-90	EGS Motor Mount	In this packet
2009S-00	Storage Assembly	In this packet
2009S-10	Storage: Side	In this packet
2009S-20	Storage: Rear	In this packet
2009S-30	Storage: Partition	In this packet
2009S-40	Storage: Roof Assembly	In this packet
2009S-50	Storage: Flags	In this packet
2009OP-00	Operator Platform	In this packet
2009PC-00	Processing Cell Assembly	In this packet
2009PC-10	Catalyst Dispenser	In this packet
2009PC-11	Small Motor Hub	In this packet
2009PC-12	Dispenser Cam	In this packet
2009PC-20	Energy Receptacle	In this packet
2009PC-30	Tall CO2 Receptacle	In this packet
2009PC-40	Catalyst Receptacle	In this packet
2009PC-50	H2O Receptacle	In this packet
2009PC-60	Stratosphere Support Leg	In this packet
2009PC-70	Processing Cell Base	In this packet

2009PC-80	PVC Pipe Plug Mod	In this packet
2009PC-90	Auxillary Cell Towers	In this packet
2009BT-00	Benzene Tanker	In this packet
2009WR-00	Floor Wiring Assembly	Separate document
2009FPW-00	Floor Perimeter Wall Assembly	In this packet
2009CO2-00	CO2 Leader Line	In this packet
2009CS-01	Cutsheet: PVC	In this packet
2009CS-02	Cutsheet: 1/8" Hardboard	In this packet
2009CS-03	Cutsheet: 3/8" Plywood	In this packet
2009CS-04	Cutsheet: 1/2" Plywood	In this packet

2009Top-20: Floor Build Tips and Guide

The instructions on each drawing are essential:

The bulk of the drawings in this drawing package are a hybrid between “detail” drawings and “production instructions drawings.” Most operations rely HEAVILY on the instructions enumerated on each sheet. Do NOT attempt to complete any operation based solely on the images and dimensions on the drawing. Carefully read all the instructions on a drawing before attempting to build the part.

Drawing number convention:

Example: 2009PC-11

The first four digits represent the competition year, 2009. The year is followed by 1-3 characters representing a major assembly or group of drawings as follows:

- “Top” contains tips/guides to prepare for the build process, information relating to assembling the final game floor from completed sub-assemblies, testing and debugging the field mechanisms, and operating the interactive field components.
- “CS” represents a recommended cut order for the raw material to minimize waste.
- “BT” contains all the information needed to build the Benzene Tankers.
- “CO2” contains all the information needed to build the CO2 leader lines.
- “EGS” contains all the information needed to build the Energy Generating Station skeleton. The wiring and processor connections are covered in 2009WR-00
- “FPW” contains all the information needed to build the Floor Perimeter Wall.
- “OP” contains all the information needed to build the Operator Platforms.
- “PC” contains all the information needed to build the Processing Cells.
- “S” contains all the information needed to build the Storage units
- “SA” contains all the information needed to build a Scoring Abacus for manual scoring (optional).
- “WR” contains all the information needed to wire the interactive field.

The two digits following the dash represent the subassemblies of a major assembly. There may be as many as 10 subassemblies (e.g. The Processing Cell major assembly has 10 subassemblies numbered -10, -20, -30,...). Further, the 2009PC-11 and 2009PC-12 parts are components of the 2009PC-10 subassembly.

Recommended build order:

Once the cut-sheet operations have been completed, the subassemblies can be built independent of each other. The major assemblies can also be built independent of each

other. Within a drawing set for a given major assembly (BT, EGS, OP, etc...), you should start with the highest drawing number and work backwards. Generally, the following order is recommended:

1. Perform all cut sheet operations
2. Storage units (circle cutouts will be used on the Benzene Tankers)
3. Operator Platforms
4. Energy Generating Station
5. Processing Cells

Pilot hole and clearance hole sizes:

A *clearance hole* should be slightly larger than the major diameter of the fastener shank but significantly smaller than the diameter of the fastener head. Thus, allowing the fastener to pass freely through the part but allowing ample material to retain the head of the fastener.

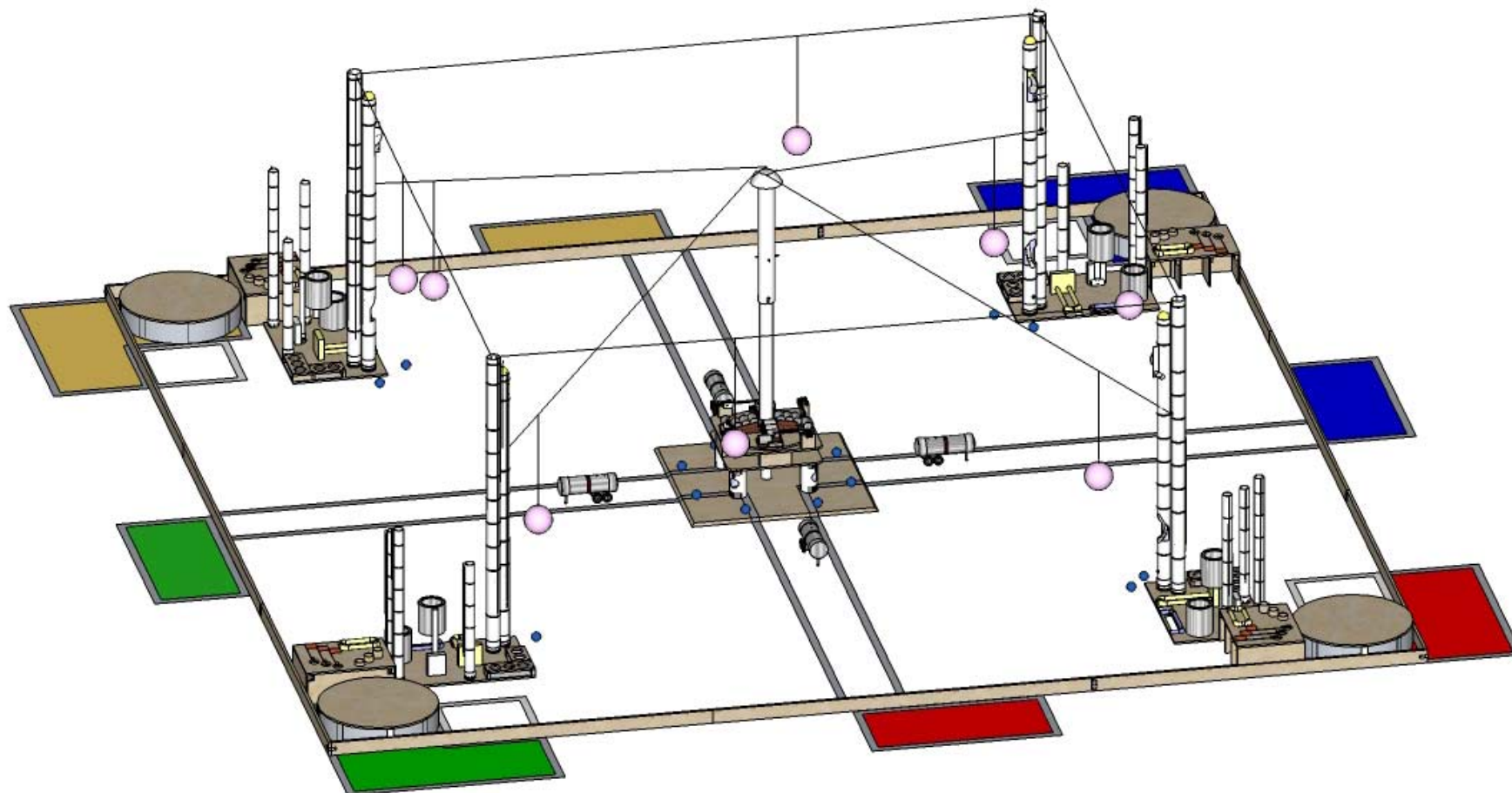
A *pilot hole* should be near in size to the minor diameter of the fasteners threads. Thus, allowing the threads to fully engage surrounding material while removing excess material that the core of the fastener would otherwise have to push out of the way.

When two parts are joined by a fastener that passes through the first part and threads into the second part, then the first part should have a clearance hole and the second part should have a pilot hole. This will allow the parts to easily abut. The following table lists easy-to-find drill bits that will suffice for the various needs in the game floor project.

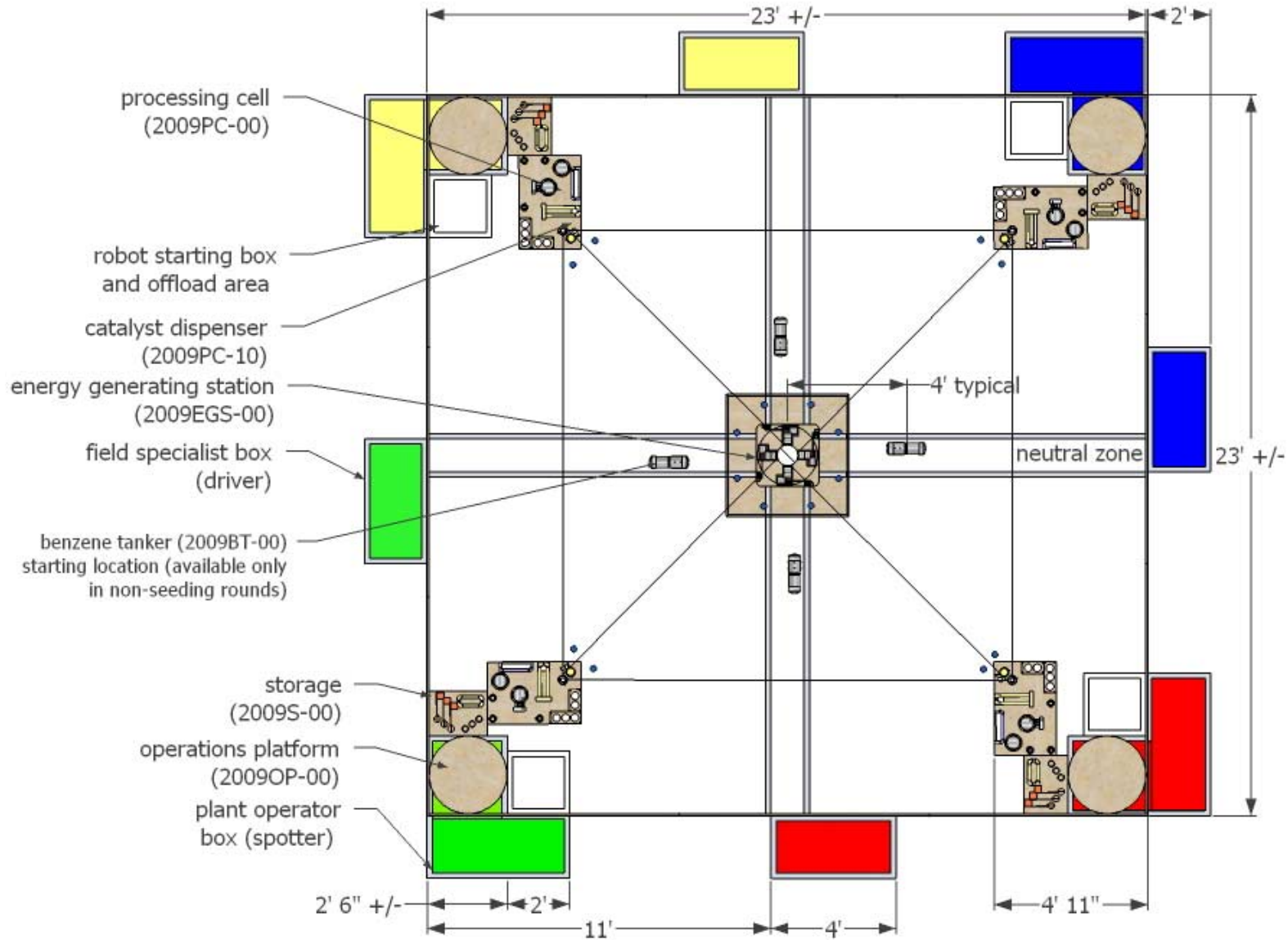
Fastener	Major dia.	Pilot Hole Dia.		Clearance Hole Dia.	
		Standard drill size	decimal equivalent	Standard drill size	decimal equivalent
#4 machine screw	.112	3/32	.094	1/8	.125
#6 woodscrew	.138	3/32	.094	3/16	.1875
#8 woodscrew	.164	1/8	.125	3/16	.1875
#8 machine screw	.164	1/8	.125	3/16	.1875
#10 machine screw	.190	5/32	.156	1/4	.250
1/4" machine screw	.250	3/16	.188	1/4	.250

2009Top-90: Revision History

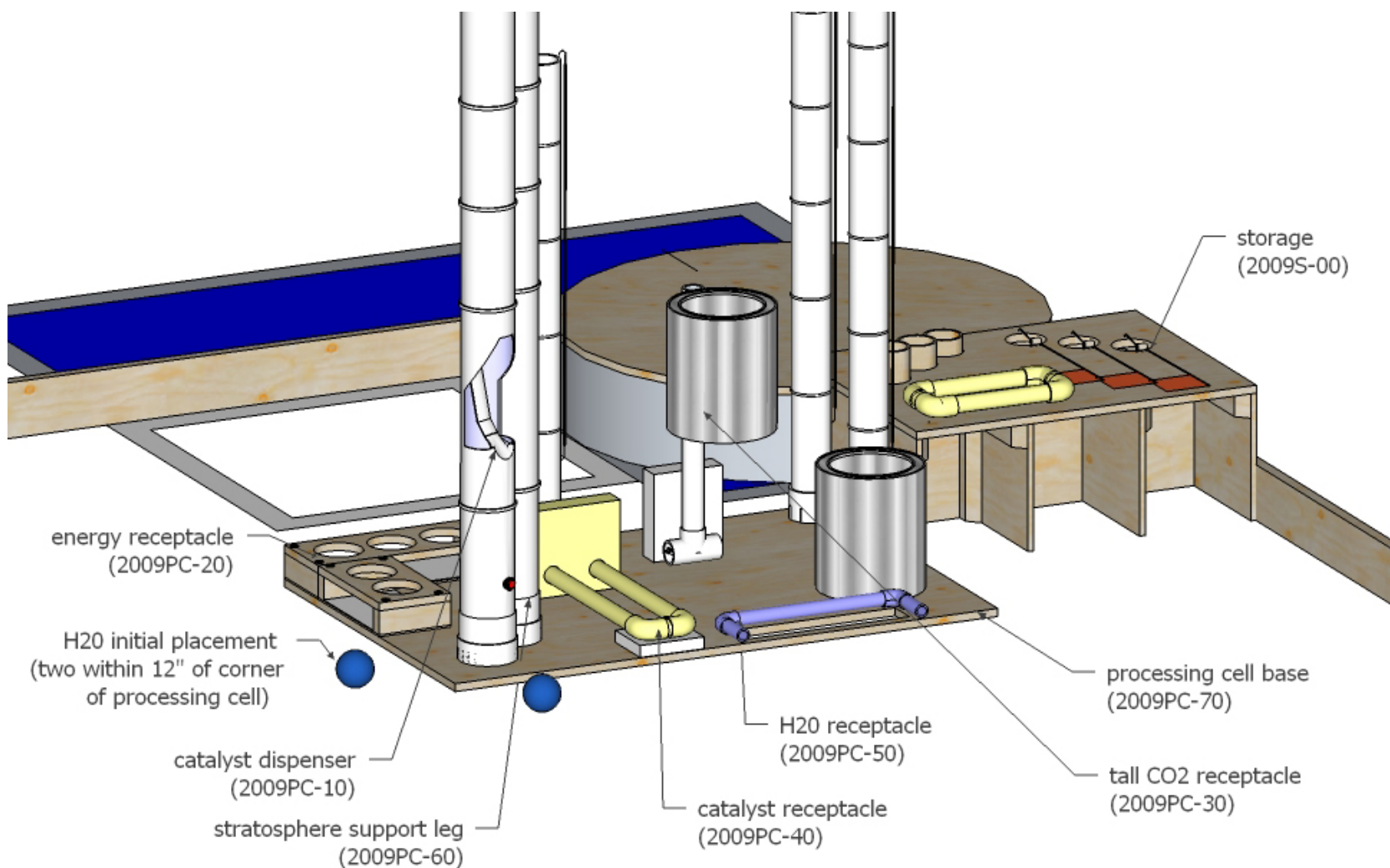
Revision 0.0	Drafts used to build prototype floor.
Revision 1.0	"As-built" documentation of most mechanical parts released for initial internal review. Released in phases.
Revision 1.1	Initial release of 2009FPW-00 and 2009EGS-90 Updated drawing package summary information on pages 2-5. Compiled all drawings into a single-file drawing package.
Revision 2.0	Extensive revision to BOM 2009CS-02 changed 6" wide piece to 7" 2009CS-03 removed extraneous pieces, added field perimeter stiffener pieces. 2009EGS-00 changed block to 8", added tensioning option, tweaked instructions 2009EGS-20 rotated cutout to facilitate tensioning 2009EGS-30 rotated large hole pattern to facilitate tensioning 2009EGS-40 added washers under pulley, called out 3-1/2" screw, changed 3/16" clearance holes to 1/4" 2009EGS-50 modified -2 Detail (was 6" now 7") 2009EGS-60 modified actuator arm and related instructions 2009EGS-70 replaced lagbolt with carriage bolt 2009PC-10 added signal flag requirement to sheet 1 2009PC-40 reduced width of block on sheet 2(now 4-1/2") 2009PC-90 modified pipe length, tweaked instructions. 2009FPW-00 changed and relocated corner brace, added joint stiffener piece.
Revision 2.1	Various corrections on BOM Updated isometric view of field, general layout, and subassembly identification views. 2009EGS-70 sh2. changed "eyehook" designations to "woodscrew eyebolt" 2009PC-40 sh2. modified length to 4-1/2" and added missing dimension. Created drawing 2009CO2-00.



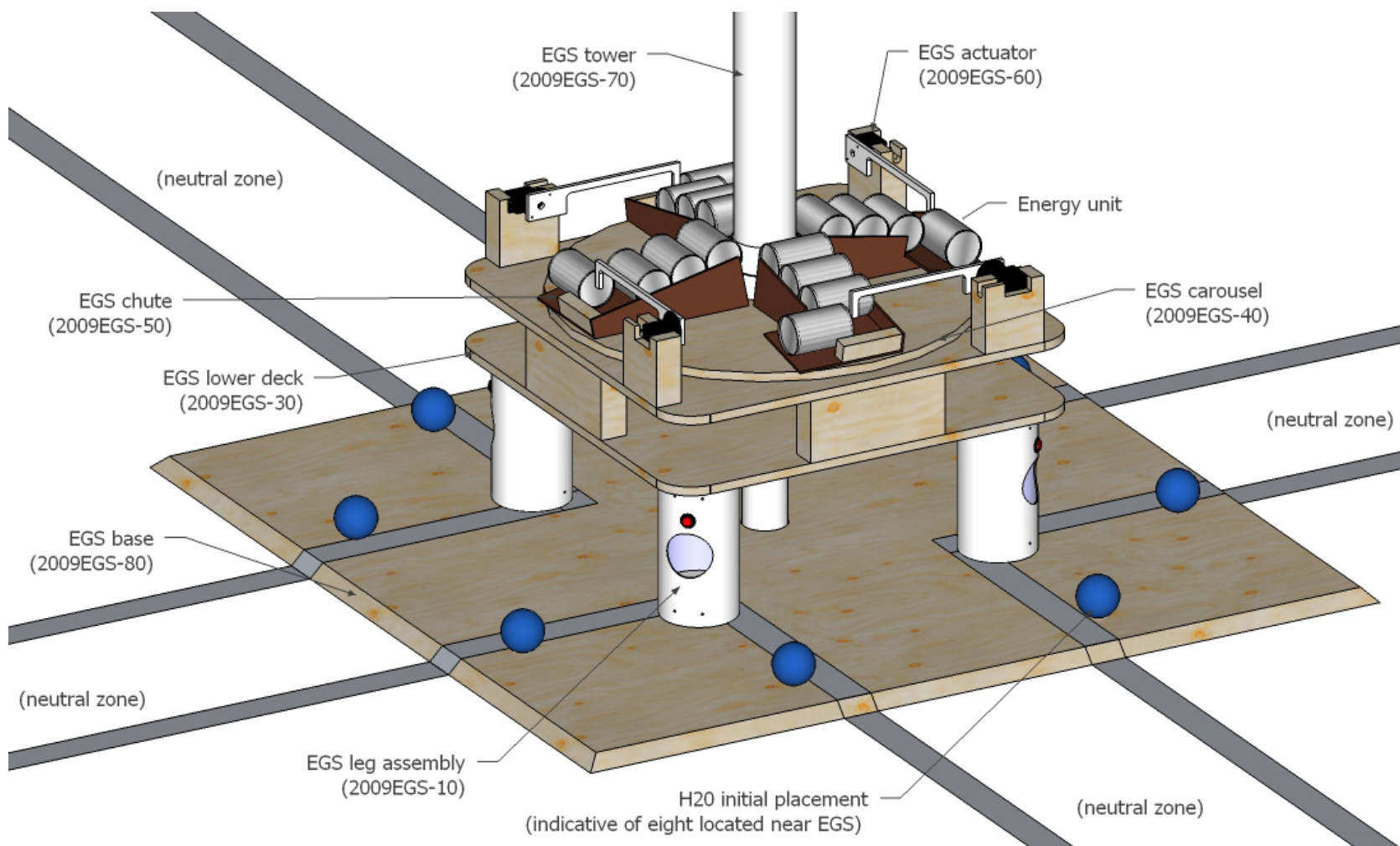
2009Top-00 sh1: Isometric View of Assembled Game Floor



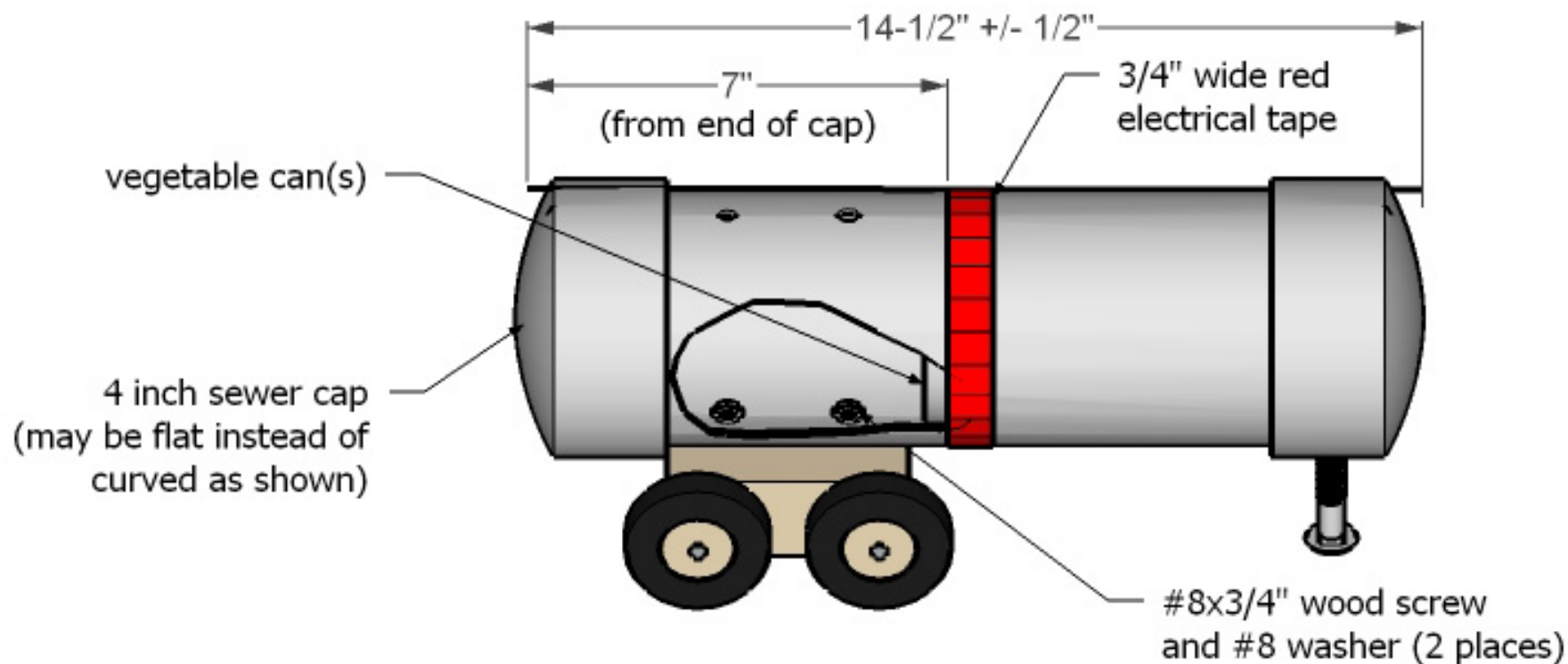
2009Top-00 sh2: General Layout of Game Floor



2009Top-00 sh3: Significant Subassemblies in the Processing Cell



2009Top-00 sh4: Significant Subassemblies in the EGS



Instructions (four required for final floor assembly)

1. Attach pipe assembly (sheet 3) to wheel assembly (sheet 2) using two #8x3/4" wood screws and #8 washers.
2. Insert one or two full canned vegetables (exact size and number to be specified at local hub practice day).
3. Install rear 4" PVC cap. Do NOT glue until vegetable can(s) have been specified and installed at practice day.
4. Optionally, all PVC components may be wrapped in aluminum duct tape or thin metal sheeting to mimic real gas tanker trucks.
5. Apply loop of red electrical tape around entire circumference of pipe. The back edge of the tape should be 7" from the rear of the final assembly. Stand the assembly straight up on its rear end and measure from the ground up to locate 7" on all sides.

Drawn by:
Brazos BEST

scale = 0

Title:

Benzene Tanker

Dwg. No.

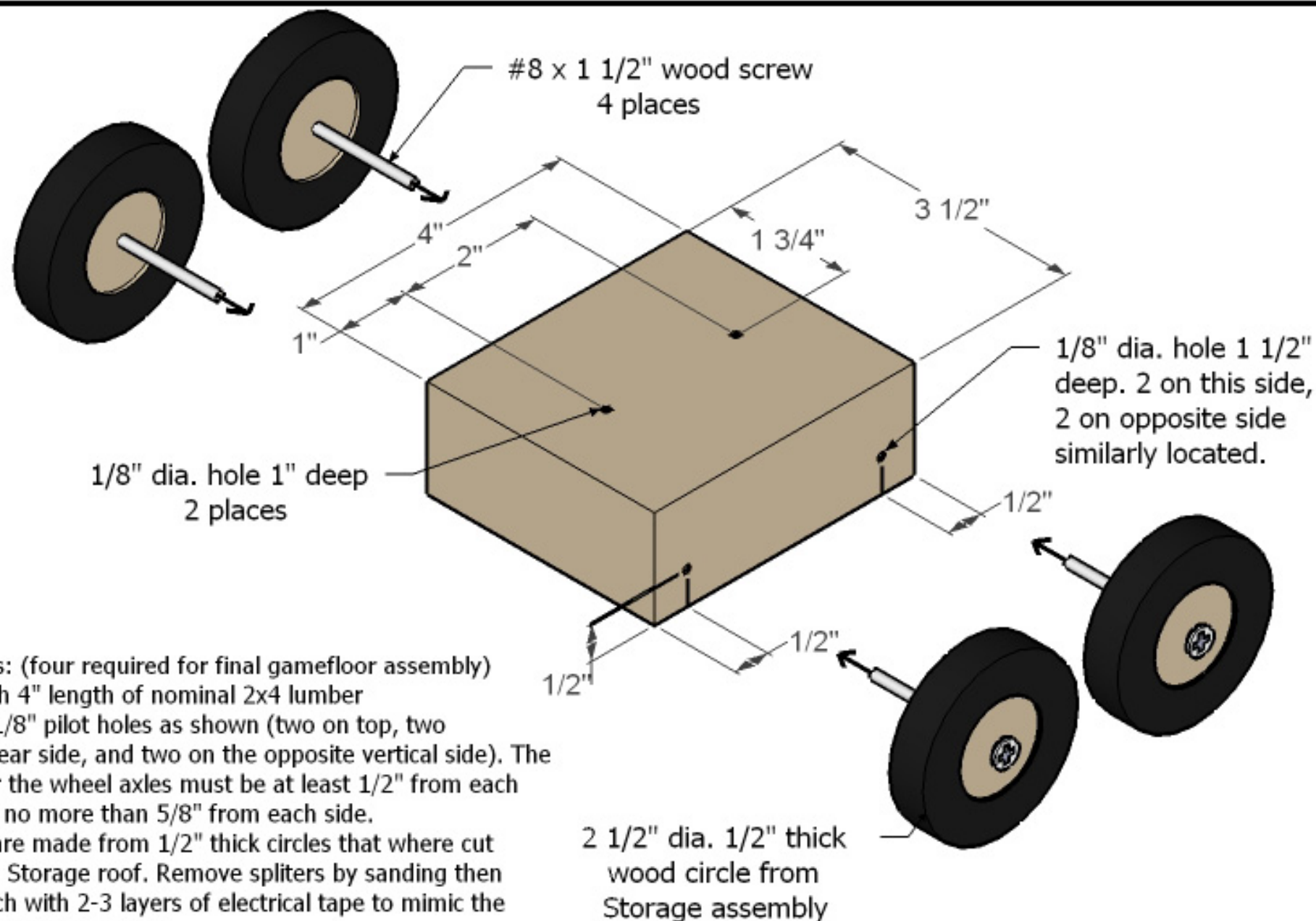
2009BT-00

Rev

1.0

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sheet 1 of 3



Instructions: (four required for final gamefloor assembly)

1. Start with 4" length of nominal 2x4 lumber
2. Drill six 1/8" pilot holes as shown (two on top, two on the near side, and two on the opposite vertical side). The holes for the wheel axles must be at least 1/2" from each side and no more than 5/8" from each side.
3. Wheels are made from 1/2" thick circles that were cut from the Storage roof. Remove splinters by sanding then wrap each with 2-3 layers of electrical tape to mimic the rubber tread on a wheel.
4. Install two wheels on each side of the block using #8 x 1 1/2" wood screw through the hole in the center of the wheel. Wheels should be secure but should be free to spin. Washers may be added on either side of wheel to facilitate spinning.

Note: the pilot holes on the top surface are used in a later operation.

Drawn by:
Brazos BEST

scale = 0

Title: **Benzene Tanker**

Dwg. No.

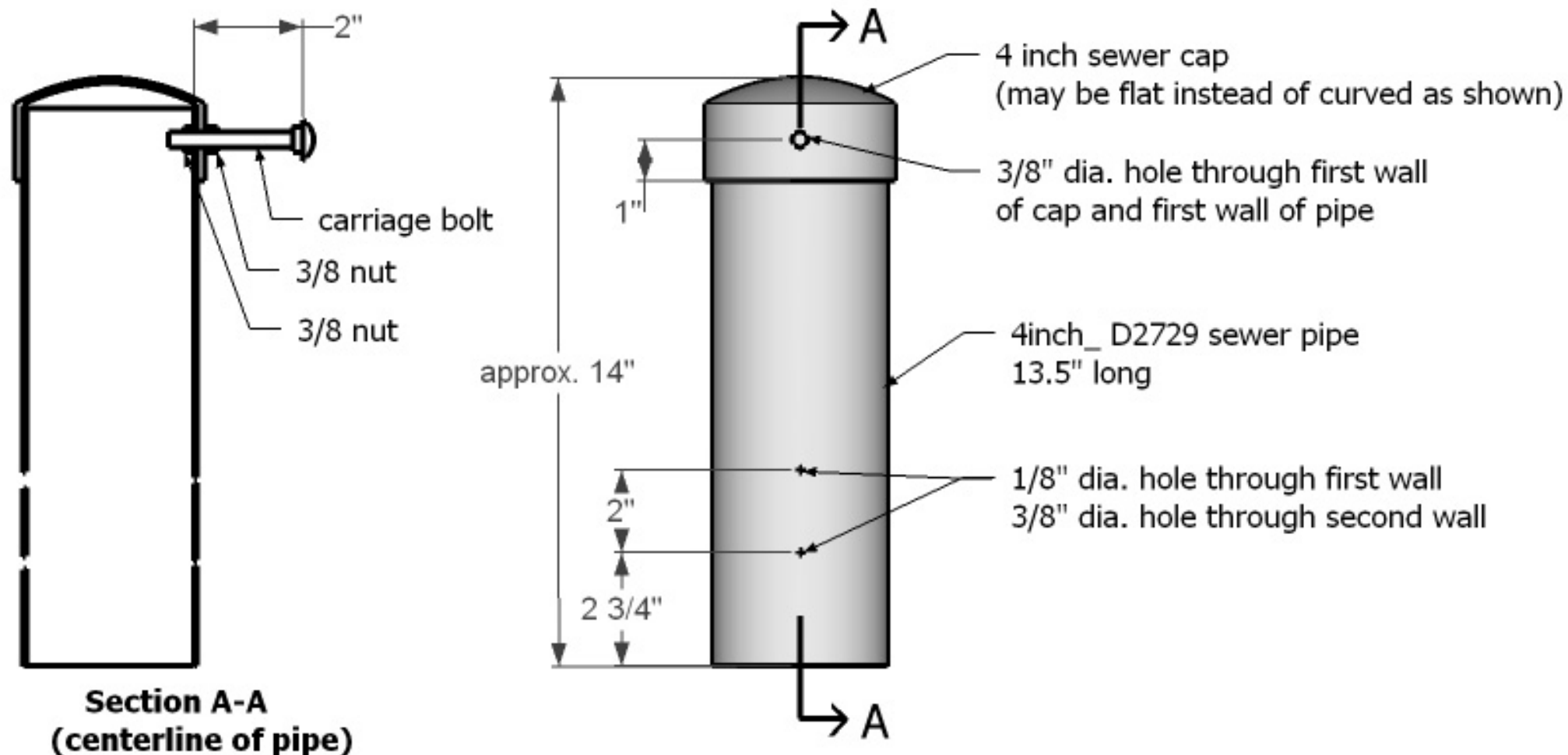
2009BT-00

Rev

1.0

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sheet 2 of 3



Instructions (four required for final floor assembly):

1. Cut length of 4" D2729 PVC pipe to 13.5".
2. Use PVC cement to install cap on one end of pipe. Use mallet as necessary to fully seat pipe in cap.
3. Drill 3/8" hole through cap and pipe. Hole should penetrate only the nearside walls of the cap and pipe.
4. Install 3/8"x3" carriage bolt and two nuts shown in Section A-A. Tighten with wrench and use locktite as necessary to prevent nuts from vibrating loose.
5. Drill 1/8" and 3/8" holes as indicated. New holes should align longitudinally on the pipe with the carriage bolt. Precision on the two new 3/8" holes (located on far side of pipe) need only allow for a screwdriver to drive screws through the 1/8" holes in a later operation.

Drawn by:
Brazos BEST

scale = 0

Title:

Benzene Tanker

Dwg. No.

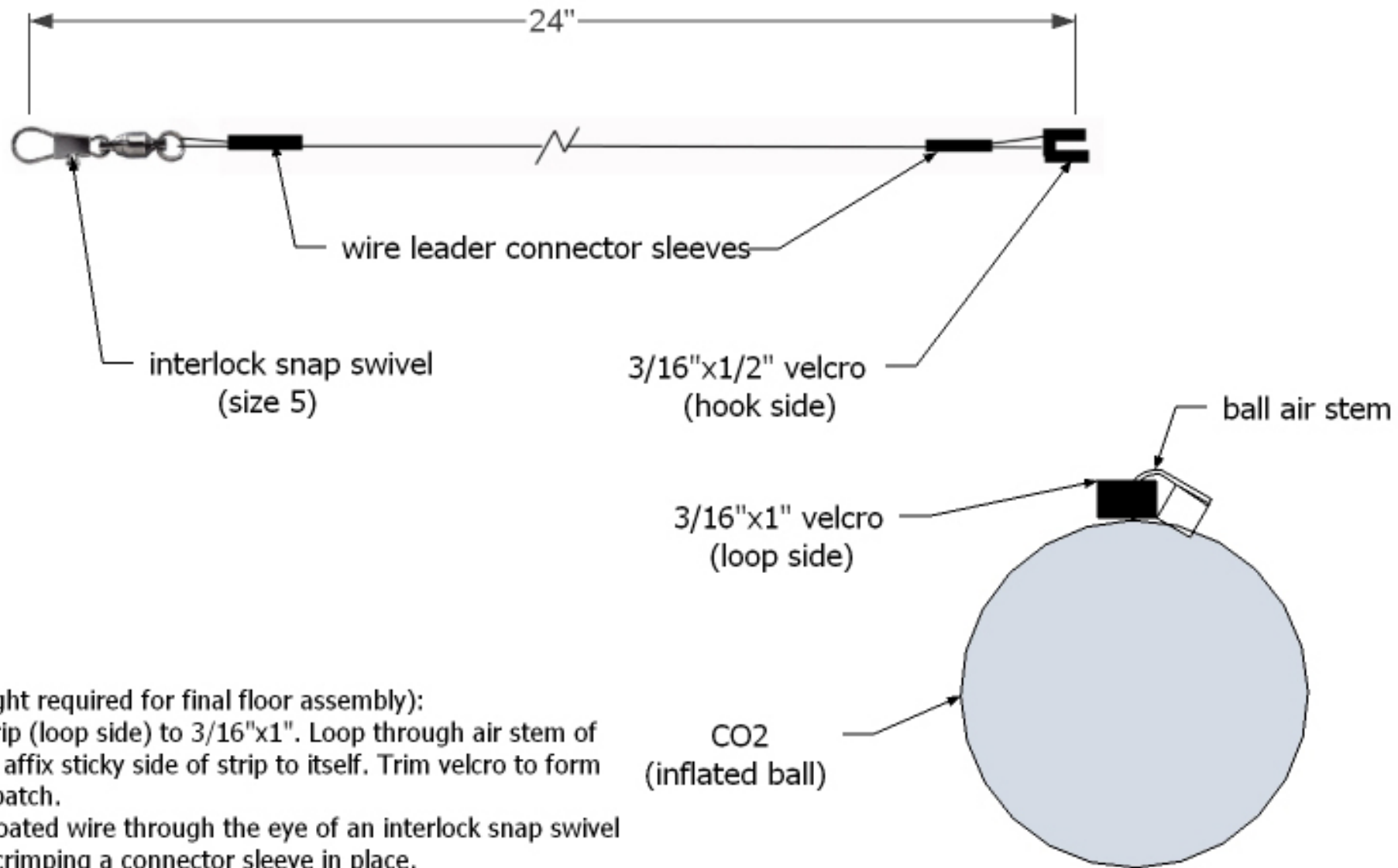
2009BT-00

Rev

1.0

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sheet 3 of 3



Instructions (eight required for final floor assembly):

1. Cut velcro strip (loop side) to 3/16"x1". Loop through air stem of CO2 ball and affix sticky side of strip to itself. Trim velcro to form a 1/4"x1/4" patch.
2. Loop nylon coated wire through the eye of an interlock snap swivel and affix by crimping a connector sleeve in place.
3. Cut wire so that final assembly will be approximately 24" in length.
4. Loop free end of wire around a 3/16"x1/2" strip of velcro (hook side) and secure loop by crimping a connector sleeve in place.
5. Fold velcro strip back on itself and affix sticky side of strip to itself. Trim velcro to form a 1/4"x1/4" patch.

Title:

CO2 Leader Line

Dwg. No.

2009CO2-00

Rev

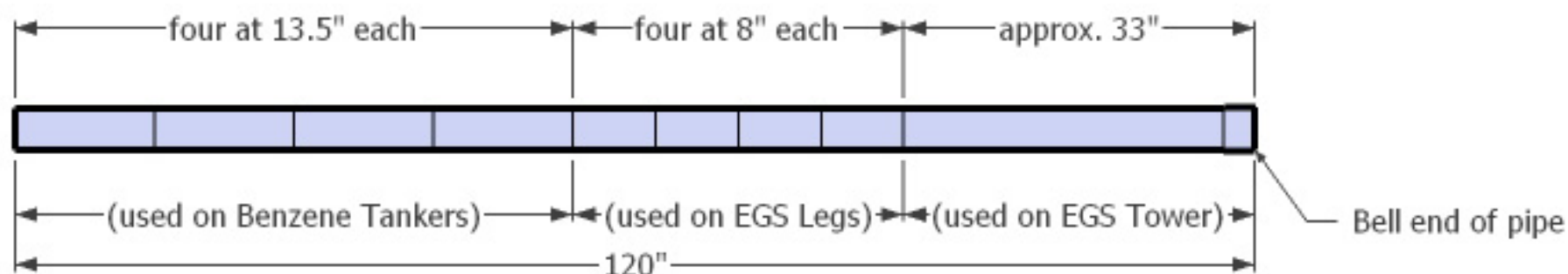
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Drawn by:
Brazos BEST

scale = 0

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sheet 1 of 1



4" Nominal Dia. PVC Pipe
(Total of ONE 10' pipe)

Instructions:

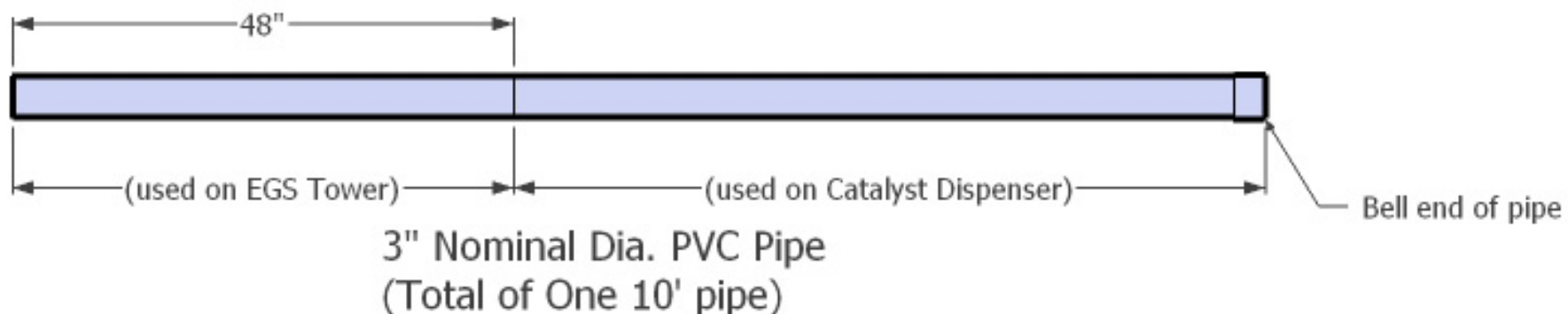
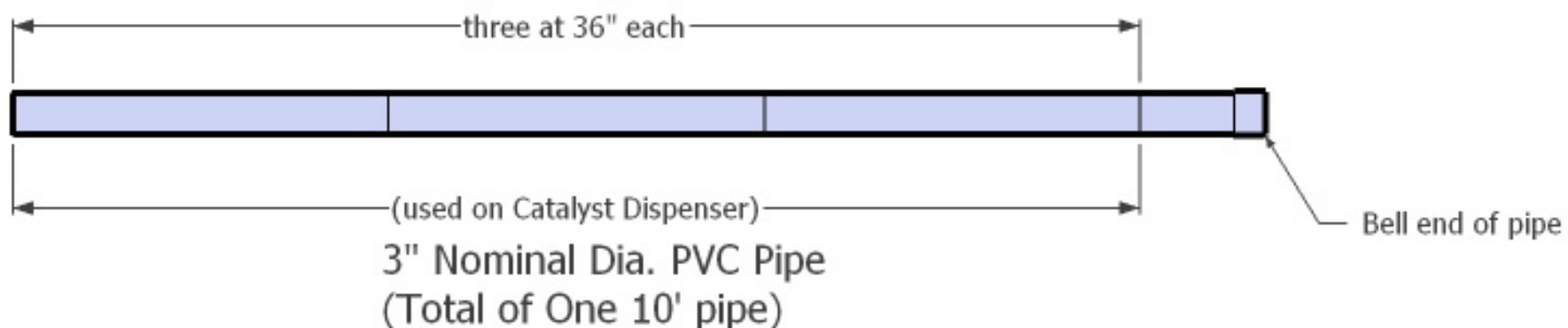
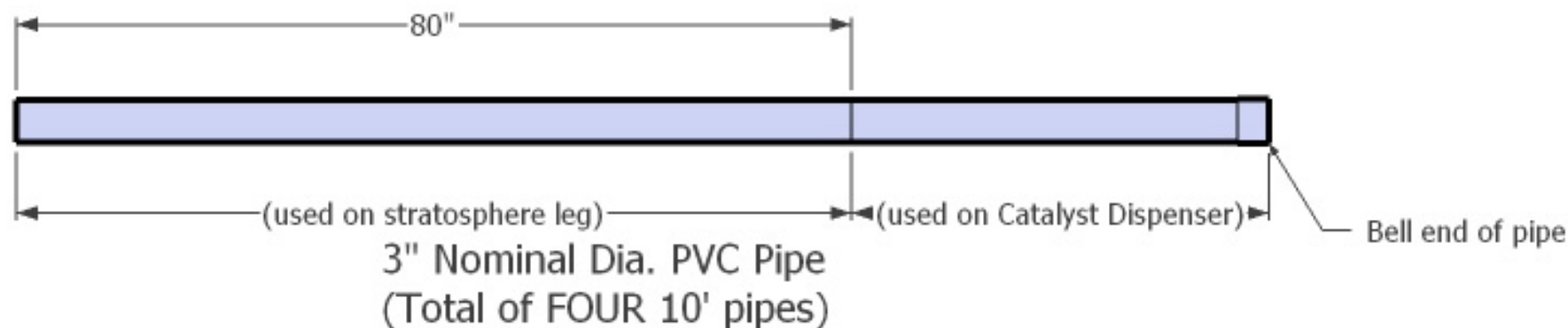
Following these recommendations will minimize project waste.
Cut from 10' pieces of PVC pipe and label as indicated for future use.

In each case "thin-walled" sewer pipe (D2729) is recommended, but more expensive sch 40 pipe can be used is necessary.

Drawn by:
Brazos BEST

scale = 0

Title: Cutsheet: PVC		
Dwg. No. 2009CS-01		Rev 1.0
BEST Robotics Inc.	sheet 1 of 2	



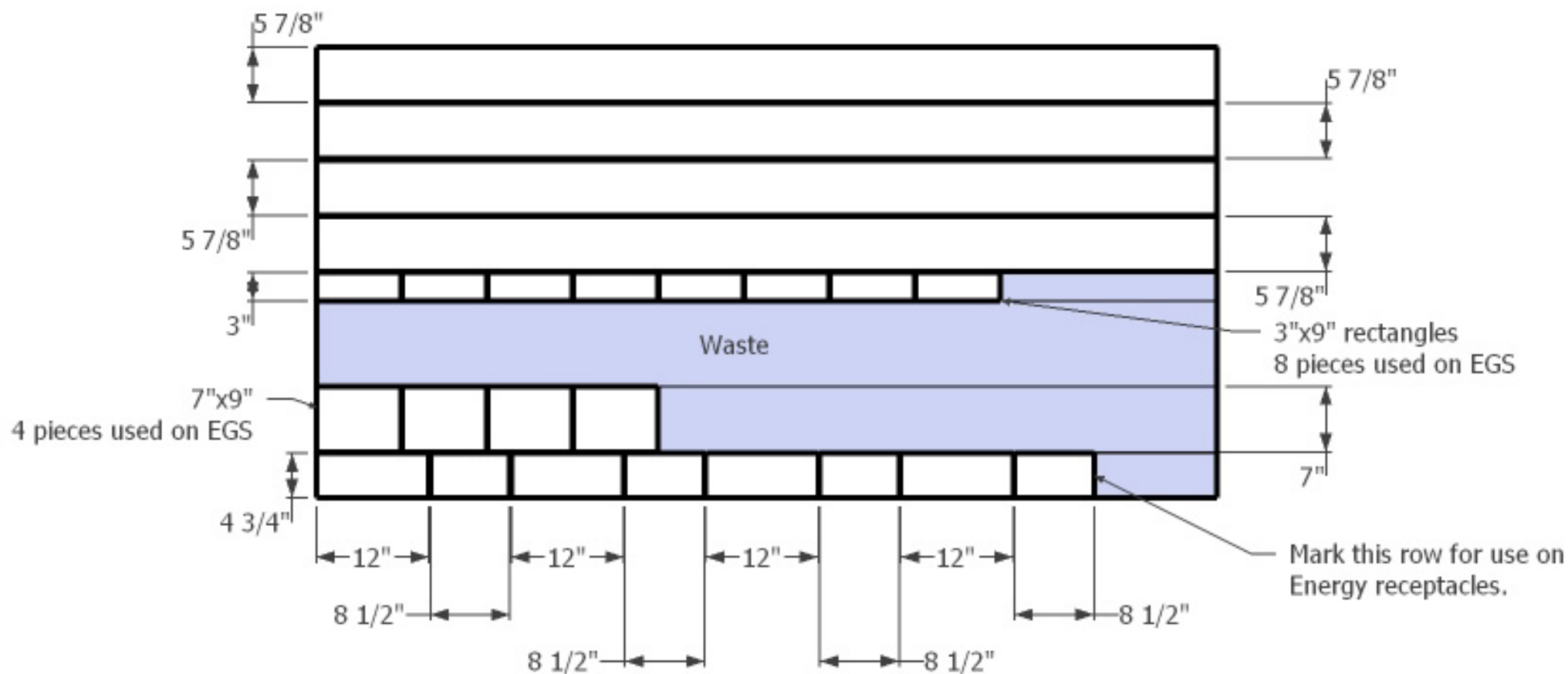
Instructions:

Following these recommendations will minimize project waste.
Cut from 10' pieces of PVC pipe and label as indicated for future use.
In each case "thin-walled" sewer pipe (D2729) is recommended, but more expensive sch 40 pipe can be used is necessary.

Drawn by:
Brazos BEST

scale = 0

Title: Cutsheet: PVC		
Dwg. No. 2009CS-01		Rev 1.0
BEST Robotics Inc.	sheet 2 of 2	



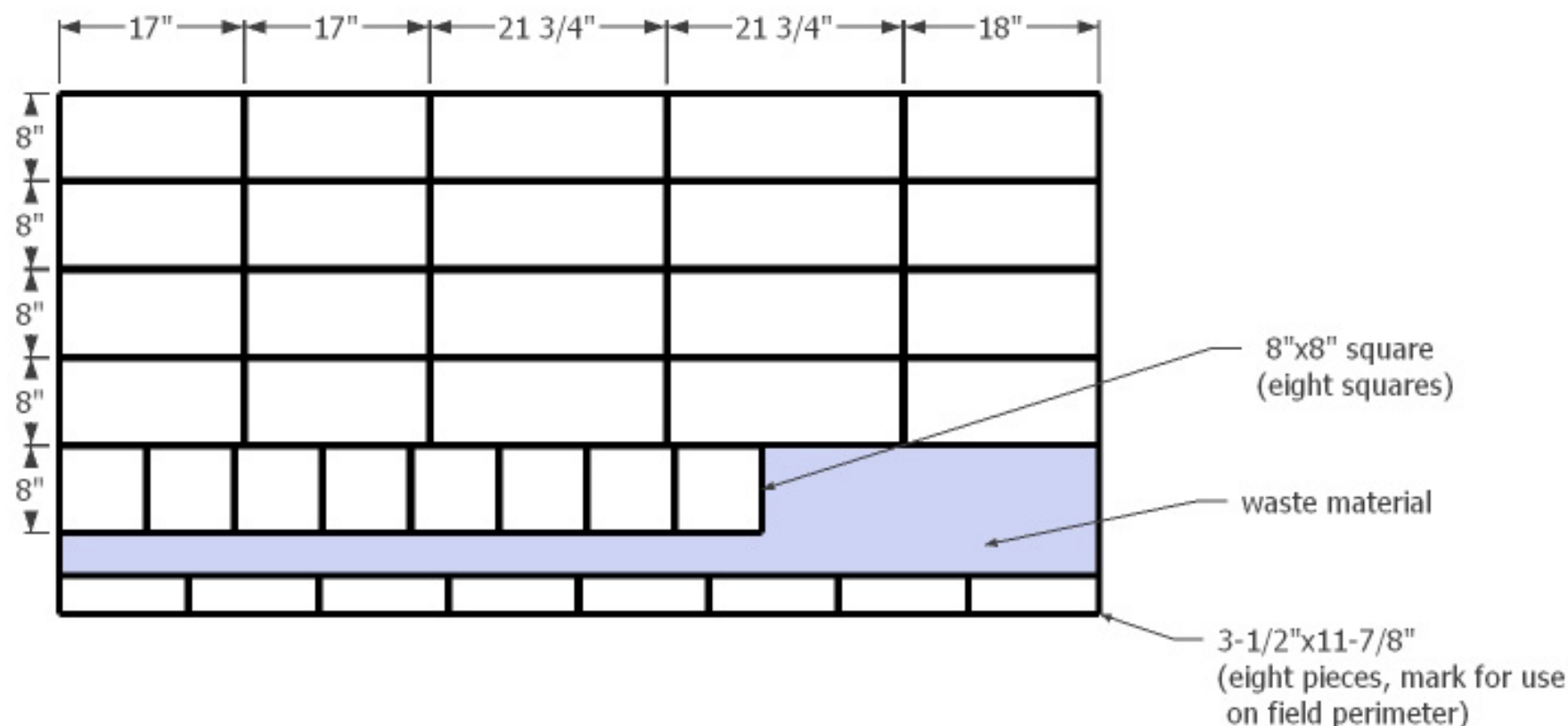
4'x8' sheet of 1/8" Hardboard
(Total ONE sheet)

Instructions:

- Following these recommendations will minimize project waste.
1. Rip longitudinal cuts first from 1/8" hardboard using table saw.

Title: Cutsheet: 1/8"hardboard		
Dwg. No. 2009CS-02		Rev 2.0
scale = 0	BEST Robotics Inc.	sheet 1 of 1

Drawn by:
Brazos BEST



4'x8' sheet of 3/8" plywood
(Total of ONE sheet)

Instructions:

All dimensions shown should be the final size of each piece with tolerances + 0, - 1/8"

1. Cut from sheet of 3/8" plywood.
2. Rip all longitudinal cuts using table saw first.
3. The various 8" wide pieces will serve as walls to a box. Therefore, it is important that all the 8" widths match each other very closely.
4. Use miter saw to cut smaller pieces from longitudinal strips.

Drawn by:
Brazos BEST

scale = 0

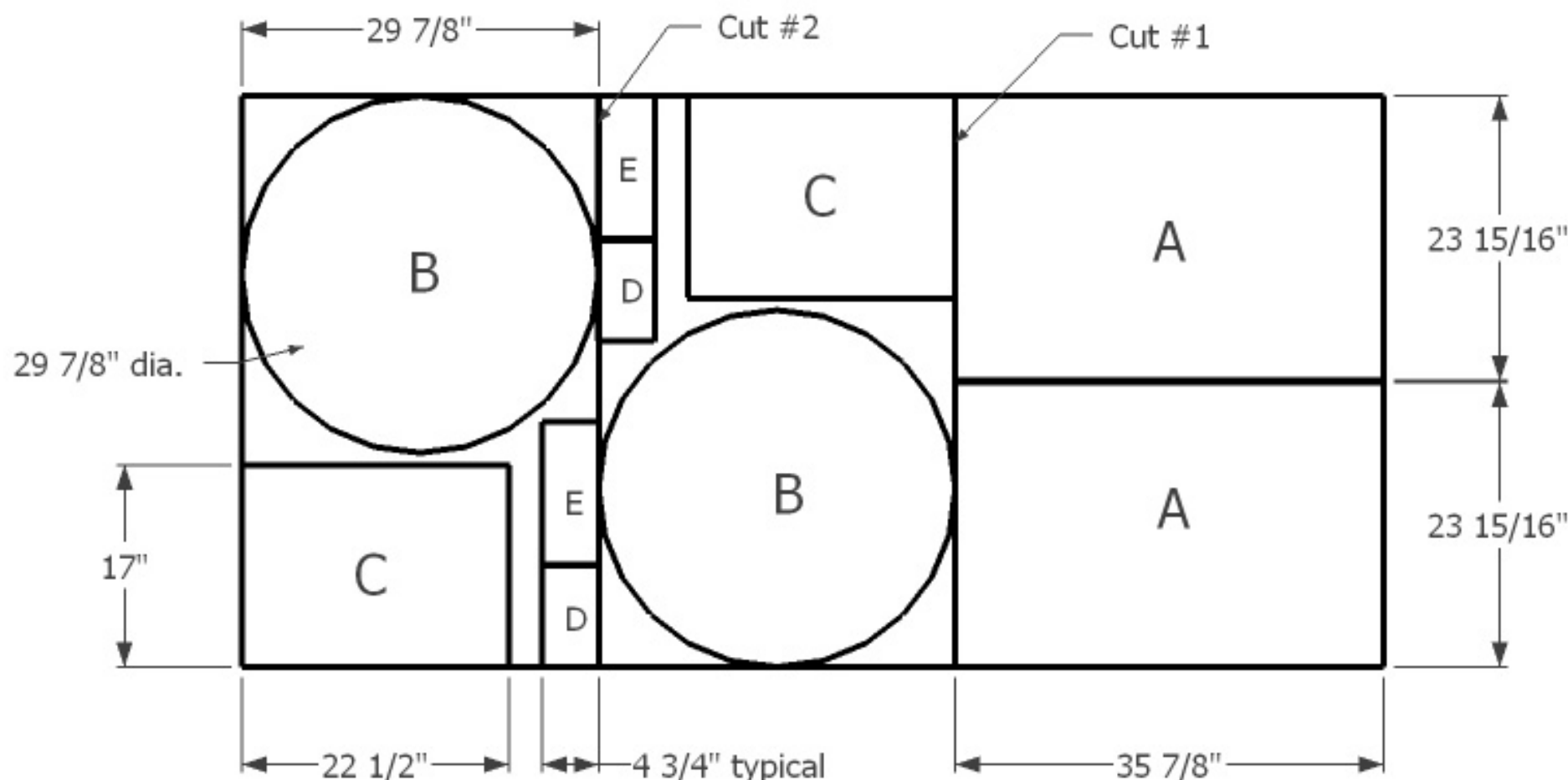
Title: **Cutsheet: 3/8"plywood**

Dwg. No. **2009CS-03**

Rev
2.0

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sheet 1 of 1



4'x8' sheet of 1/2" plywood
(Total of TWO sheets)

Instructions:

1. Starting with full sheet of 1/2" plywood, make cut #1 and cut #2 with circular saw.
2. Mark items labeled A and cut with a table saw.
3. Mark items labeled B. Clearly mark the center before cutting, then cut the circle with a jig saw.
4. Mark items labeled C and cut with a table saw.
5. Mark items labeled D and E and cut with a table saw.
Item D final dimensions are 4 3/4" by 8 1/2".
Item E final dimensions are 4 3/4" by 12".
6. Label items for use on assemblies as shown in table.

item	used on
A	Processing cell floor
B	Operator platform
C	Storage roof
D	Energy receptacle -3
E	Energy receptacle -2

Title:

Cutsheet: 1/2"Plywood

Dwg. No.

2009CS-04

Rev

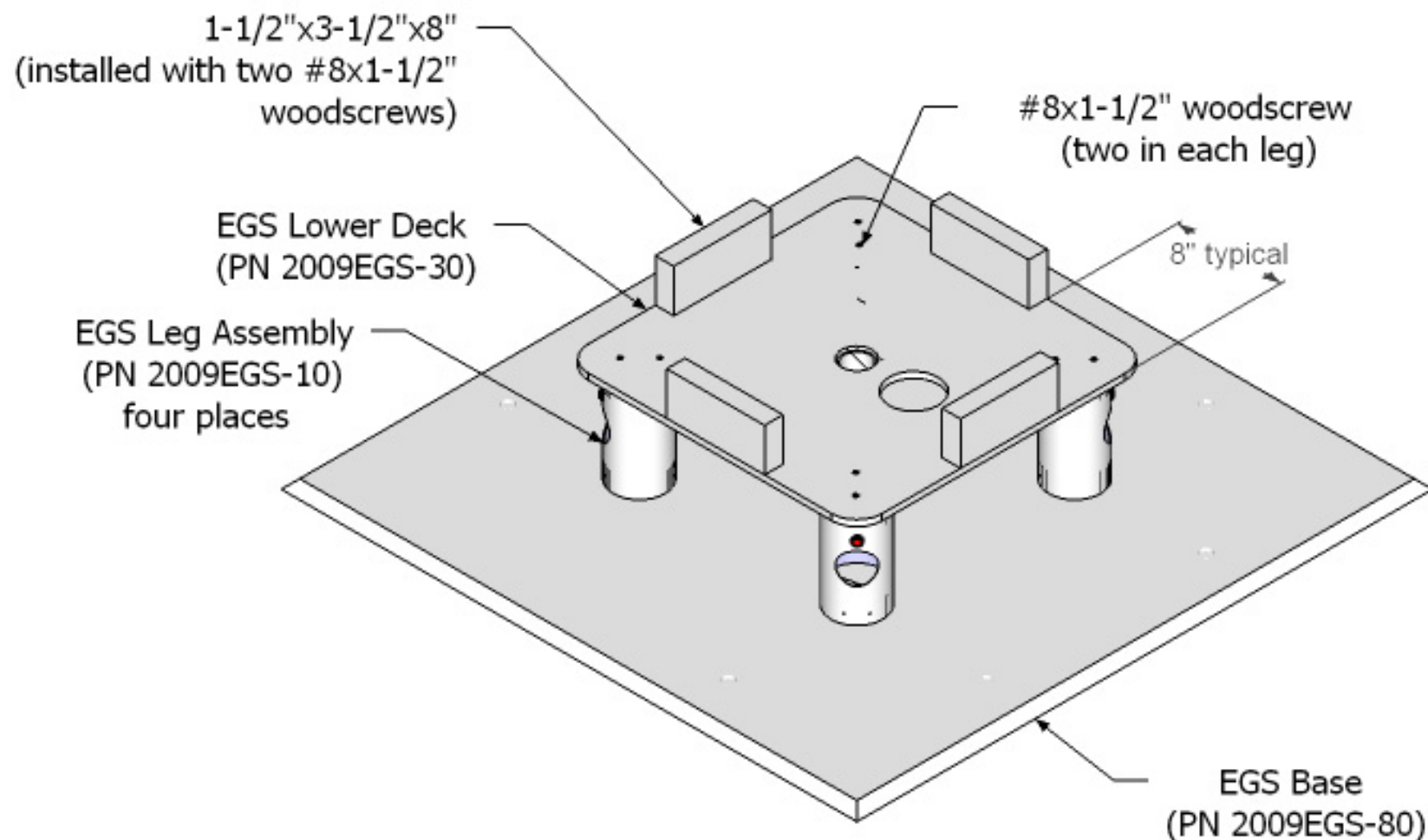
1.0

Drawn by:
Brazos BEST

scale = 0

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sheet 1 of 1



Instructions:

1. Locate Leg Assembly 1-1/2" from each edge of EGS Lower Deck.
Align pushbutton with the corner of the deck.
2. Affix each leg with two #8x1-1/2" woodscrews through the deck and into the Leg Mount.
3. Cut 8" lengths of nominal 2x4 lumber and install on each edge approx. 8" from the left edge (approx. centered on the side). The board should be flush with the edge of the deck. Affix using two #8x1-1/2" woodscrews.
4. Center the assembly atop the EGS Base and affix using four #8x1-1/2" woodscrews through the base and into the leg mount. (One screw in each leg)

Drawn by:
Brazos BEST

scale = 0

EGS Assembly

Dwg. No.

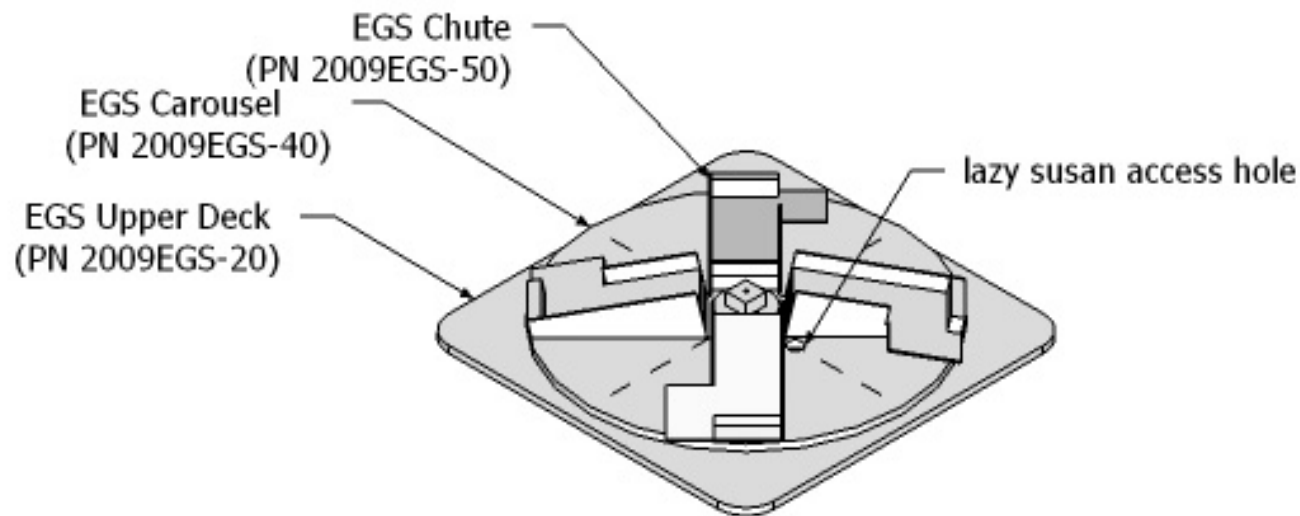
2009EGS-00

Rev

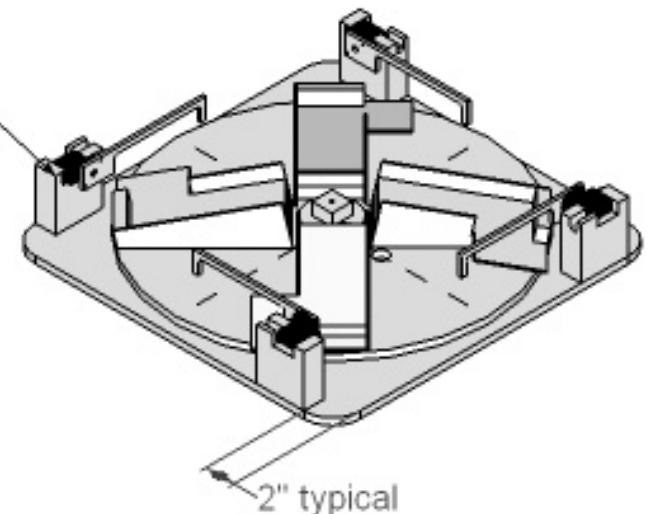
2.0

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sheet 1 of 4



EGS Actuator
(PN 2009EGS-60)



Instructions:

1. Center the EGS Carousel atop the EGS Upper Deck. Affix using #8x3/4" woodscrews through the lazy susan access hole.
2. Position one EGS Chute in each quadrant of the carousel. Locate as close to the carousel center as possible while still allowing the tower to thread onto the modified pipe plug. Affix to the carousel with a generous amount of velcro type fastener.
3. Locate EGS Actuator on each side, two inches from the adjacent edge oriented as shown.
4. Affix to upper deck using two #8x1-1/2" woodscrews. Precede screws with clearance holes and pilot holes as necessary to close gaps and prevent splitting.
5. Rest the assembly atop the lower EGS assembly, load the chutes with Energy units, and test the dispensing by manually turning the carousel.
6. Adjust the screw in each actuator arm to reliably dispense energy units and to miss the chute side. The side of the chutes may "nibbled" away using pliers if necessary to avoid interference.

Drawn by:
Brazos BEST

scale = 0

Title:

EGS Assembly

Dwg. No.

2009EGS-00

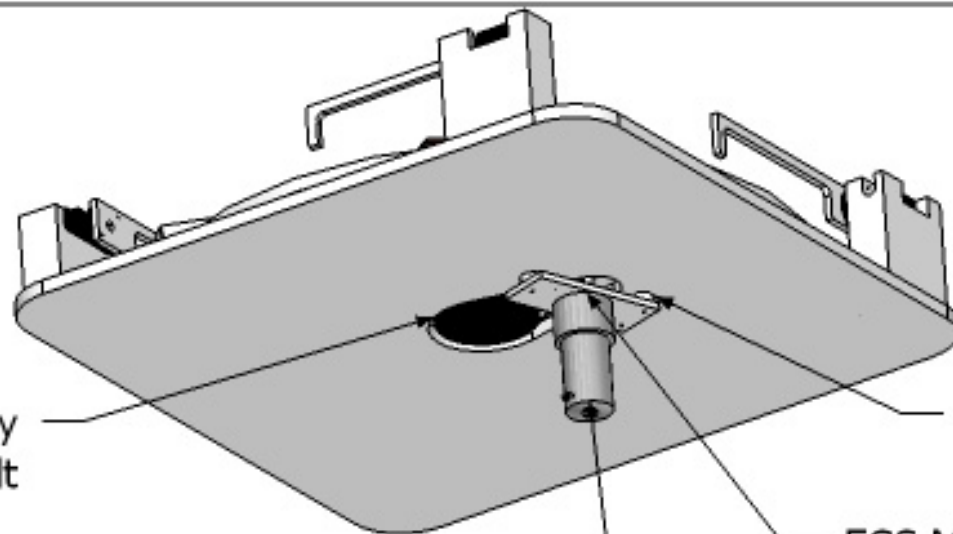
Rev

2.0

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sheet 2 of 4

plastic pulley
180 groove looped belt



3/8" nut
3 places

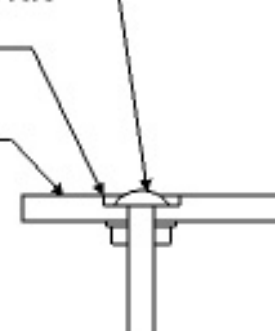
EGS Motor Mount
(PN 2009EGS-90)

large Globe motor

screw, washer, nut

counterbore

deck



Detail A

(Optional hitching post)

Instructions:

1. Install the motor on the EGS Motor Mount (PN 2009EGS-90) using two #10x1/2" screws.
2. Install the small pulley (A 6T16-018DF2508) on the motor shaft. If the pulley has a 3/16" dia. bore, it must first be carefully re-drilled to 1/4" dia. bore.
3. Flip the EGS assembly over or stand on its side to access the underside.
4. Loop the drive belt (PN A 6Z16-180025) around the drive pulley and the motor pulley.
5. Anchor one end of the motor mount using a 1" woodscrew. Use a 3/8" nut as a spacer between the motor mount and the bottom of the deck.
6. Rotate the motor assembly to tighten the belt. Make sure that both sides of the belt are taught.
- 7a. (for static mounting only) Install the 2nd and 3rd motor assembly mounting screws, again using a 3/8" nut as a spacer.
- 7b. (If Bungee cord is to be used for tensioning)
 - While keeping the belt taught, loosely install a 2nd screw through the middle of the motor mounting slot and into the plywood. Again using a 3/8" nut as a spacer and use washers as necessary to allow the mount to slide relative to the screw.
 - String a 16" length of Bungee cord through the slot in the motor mount. Tie a knot to create a 3" dia. loop. Remove excess cord.
 - Pull the Bungee loop firmly towards corner of platform deck and anchor to deck with 1-1/2" long machine screw, nut, and washer as shown in Detail A.

Drawn by:
Brazos BEST

scale = 0

Title:

EGS Assembly

Dwg. No.

2009EGS-00

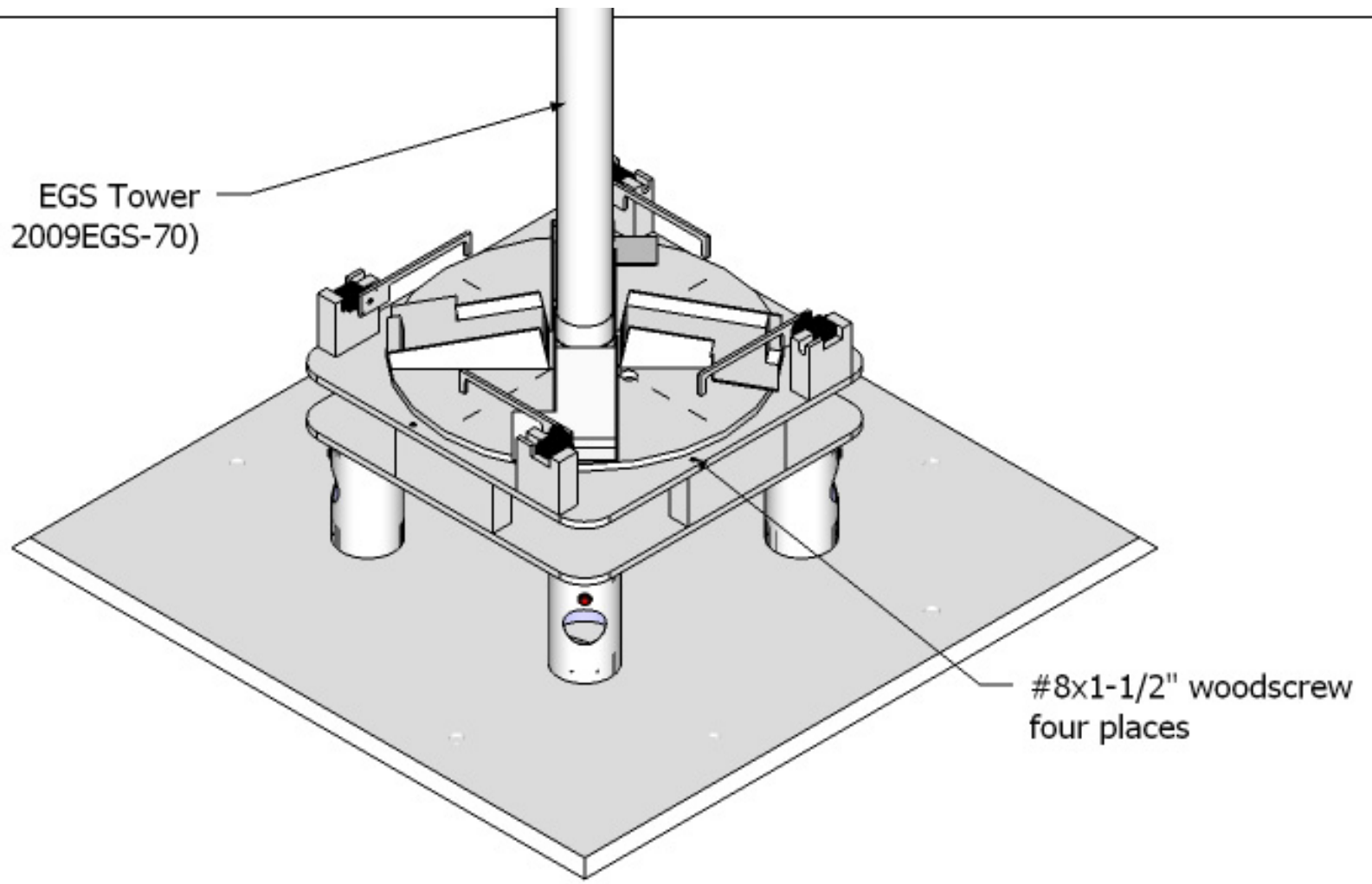
Rev

2.0

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sheet 3 of 4

EGS Tower
(PN 2009EGS-70)



Instructions:

1. Align upper and lower assemblies and affix using four #8x1-1/2 wood screws.
2. Install the EGS Tower by threading it onto the PVC pipe plug. Stabilize the carousel while threading the pipe to prevent damage to the belt and pulley.
3. Install wiring per document 2009WR-00

Title:

EGS Assembly

Dwg. No.

2009EGS-00

Rev

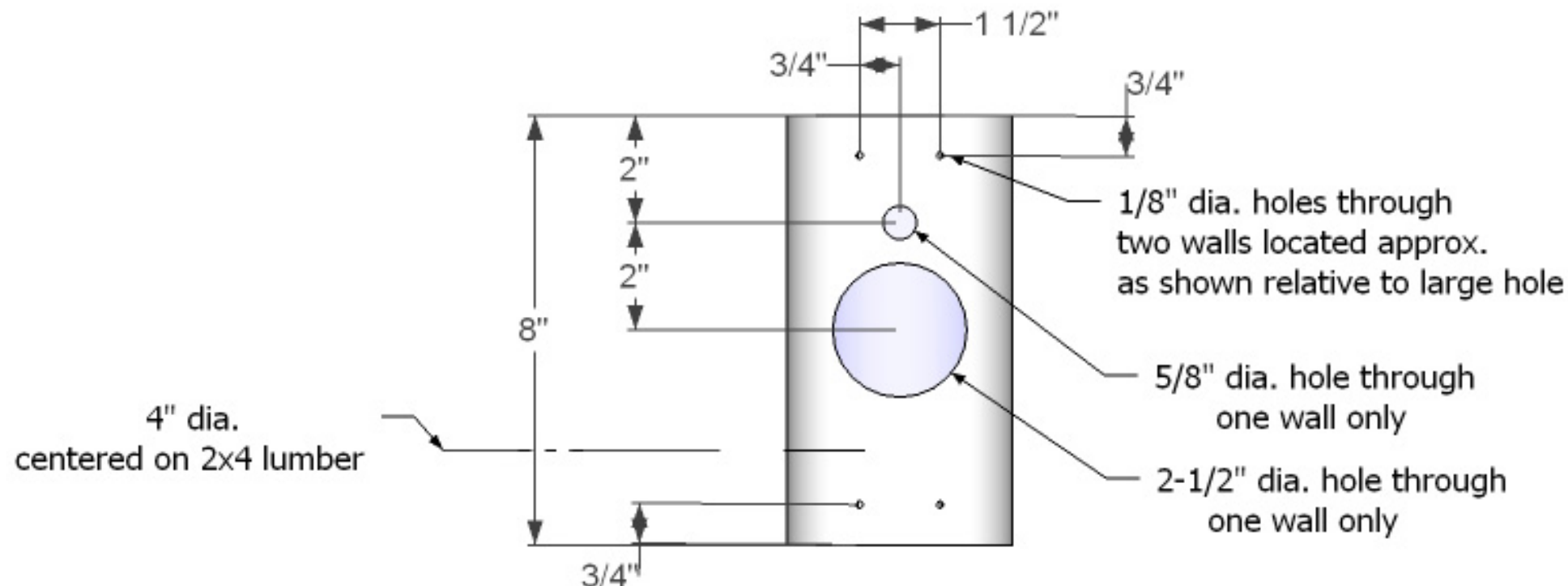
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Brazos BEST

scale = 0

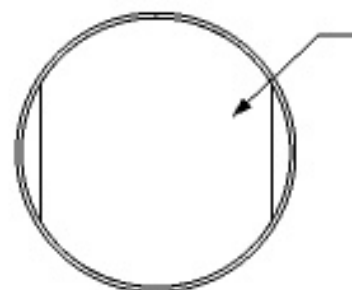
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sheet 4 of 4



Instructions (four required for final floor assembly):

1. Cut length from 4" D2729 sewer pipe (optionally can use any PVC pipe with nominal 4" O.D).
2. Drill hole using 2 1/2" hole saw. Hole will be approximately 2 5/8" diameter.
3. Drill hole with 5/8" spade bit.
4. Drill 1/8" dia. holes through both walls. Locations need only be +/- 1/4 "
5. Insert one EGS Leg Mount (Detail A) into bottom of pipe. Align bottom of mount and bottom of pipe. Secure with a minimum of two #8x1" wood screws through the 1/8" dia. holes.
6. Turn the assembly over, and install one EGS Leg Mount in the other end of the pipe following procedure in step 5.
7. Install push button (with pigtail specified in wiring diagrams) in 5/8" hole. The barrel of the push button should thread into the hole. Installation may be made easier by first heating the area with a heat gun.



EGS Leg Mount
(one on each end of pipe)
(see Detail A on sheet 2)

Title: **EGS Leg Assembly**

Dwg. No. **2009EGS-10**

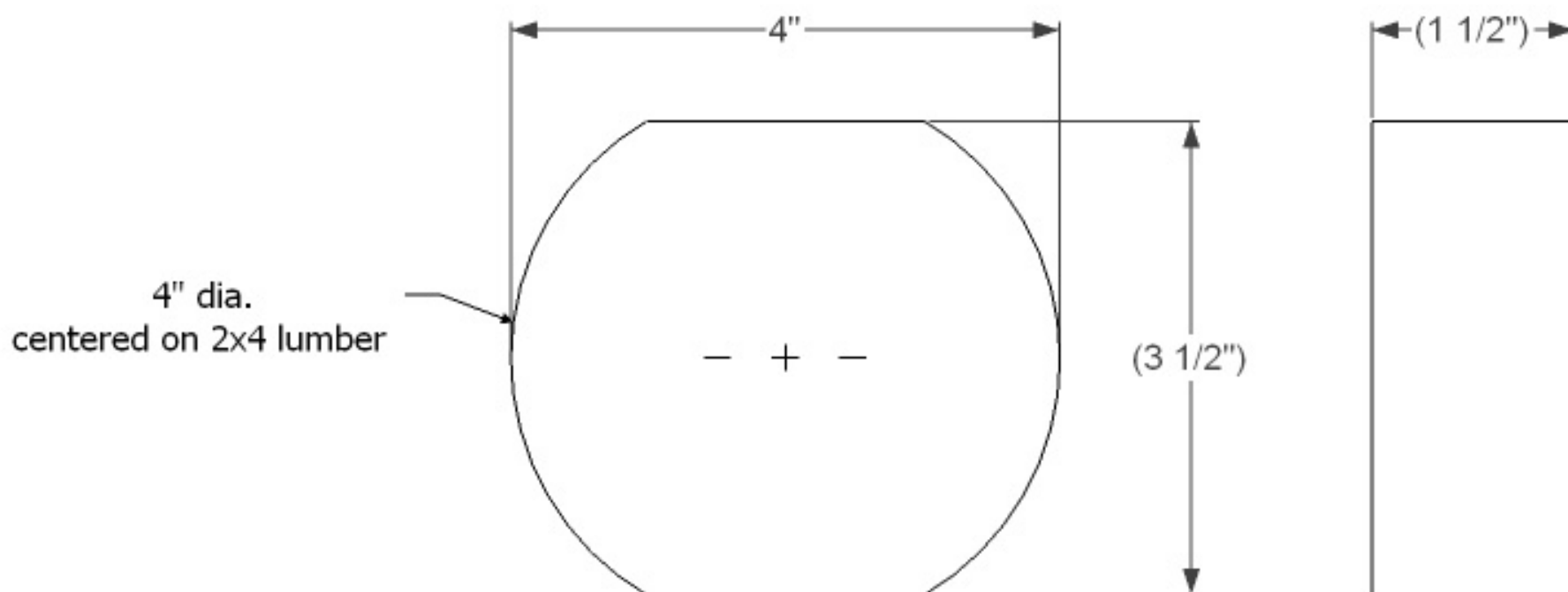
Rev
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Drawn by:
Brazos BEST

scale = 0

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sheet 1 of 2



Detail A
EGS Leg Mount

Instructions (eight required in final gamefloor assembly):

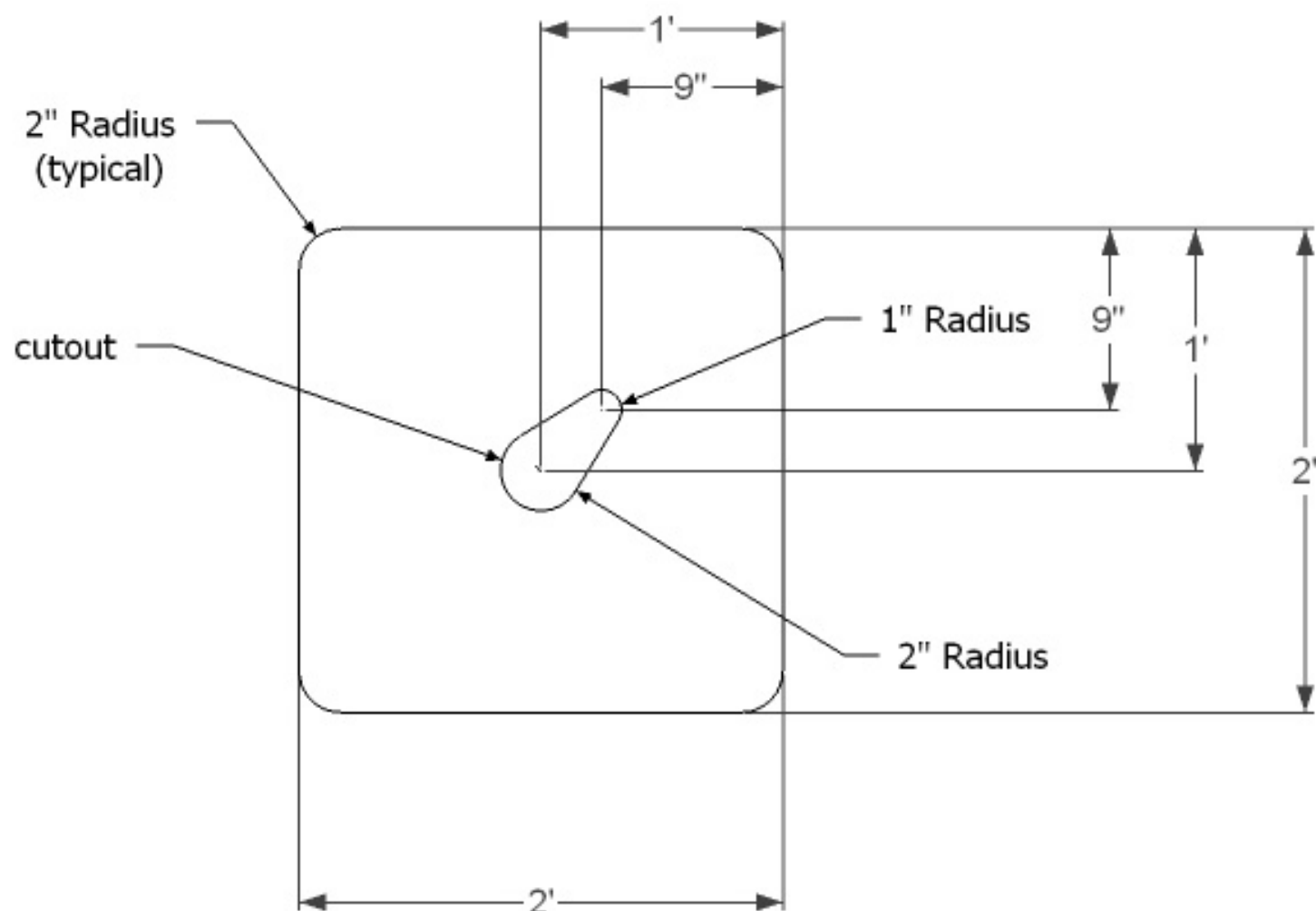
One 36" length of nominal 2x4 lumber can be used to make eight units.

1. Use short length of 4" PVC pipe and trace inner diameter onto the 2x4 workpiece. Pipe should be approximately centered on workpiece. Use the same type PVC as will be used on the EGS legs.
2. Cut arched ends using jigsaw or bandsaw. Final product should fit snugly into PVC pipe without deforming the pipe.

Drawn by:
Brazos BEST

scale = 0

Title: EGS Leg Assembly		
Dwg. No. 2009EGS-10		Rev 1.0
BEST Robotics Inc.		sheet 2 of 2



Instructions (one needed for final floor assembly):

1. Begin with approx. 2'x2' piece of 1/2" plywood.
2. Use a scrap piece of 4" PVC to mark the 2" Radius corners and cut with a jig saw.
3. Layout and cut the center cutout as shown.

Drawn by:
Brazos BEST

scale = 0

Title:

EGS Upper Deck

Dwg. No.

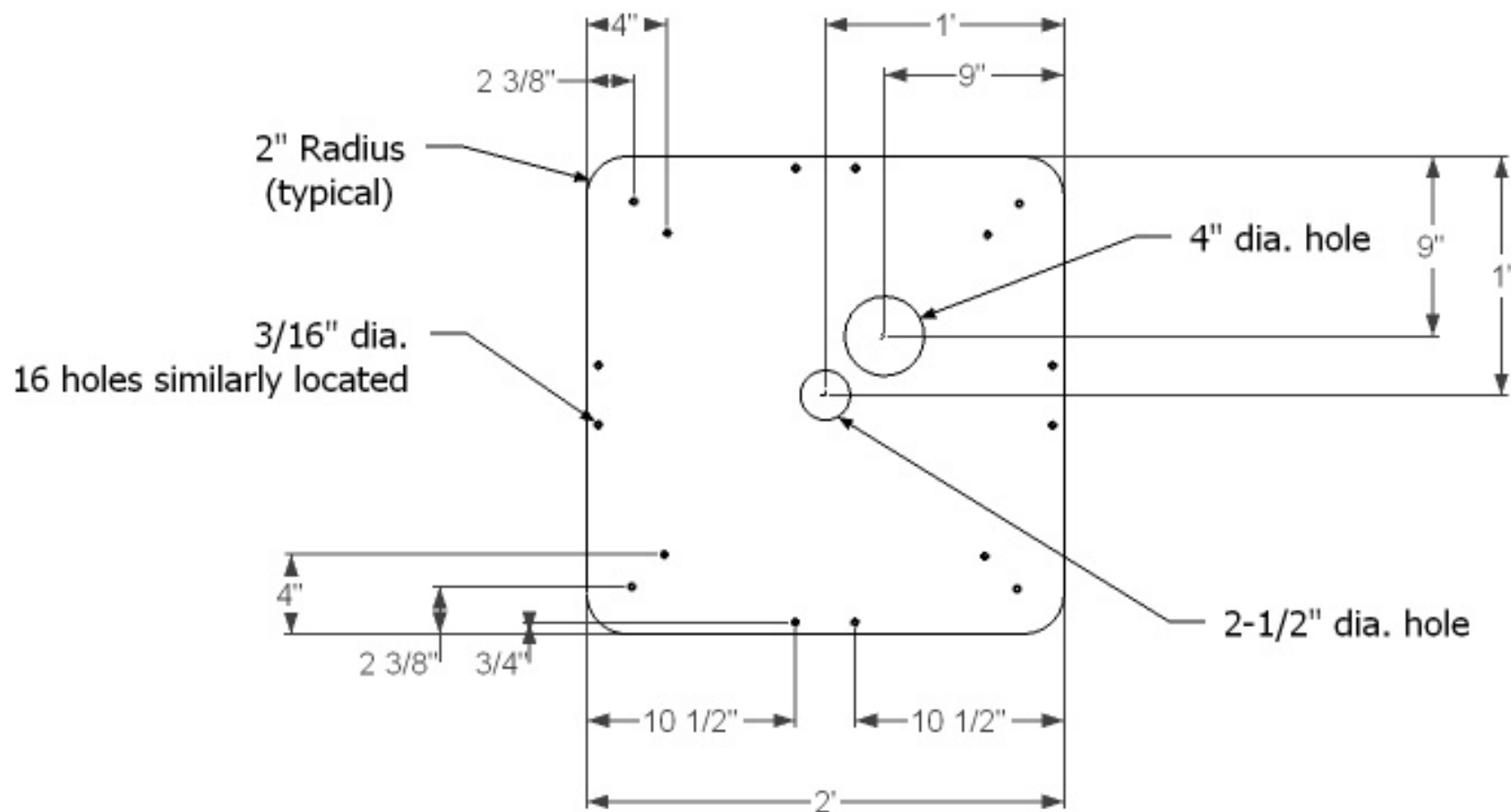
2009EGS-20

Rev

2.0

BEST Robotics Inc.

sheet 1 of 1



Instructions (one needed for final floor assembly):

1. Begin with approx. 2'x2' piece of 1/2" plywood.
2. Use a scrap piece of 4" PVC to mark the 2" Radius corners and cut with a jig saw.
3. Cut 2-1/2" hole using hole saw.
4. Mark 4" dia. hole using scrap piece of 4" PVC. Cut hole using a jig saw.
5. Roughly locate and drill 3/16" holes.

Drawn by:
Brazos BEST

scale = 0

Title:

EGS Lower Deck

Dwg. No.

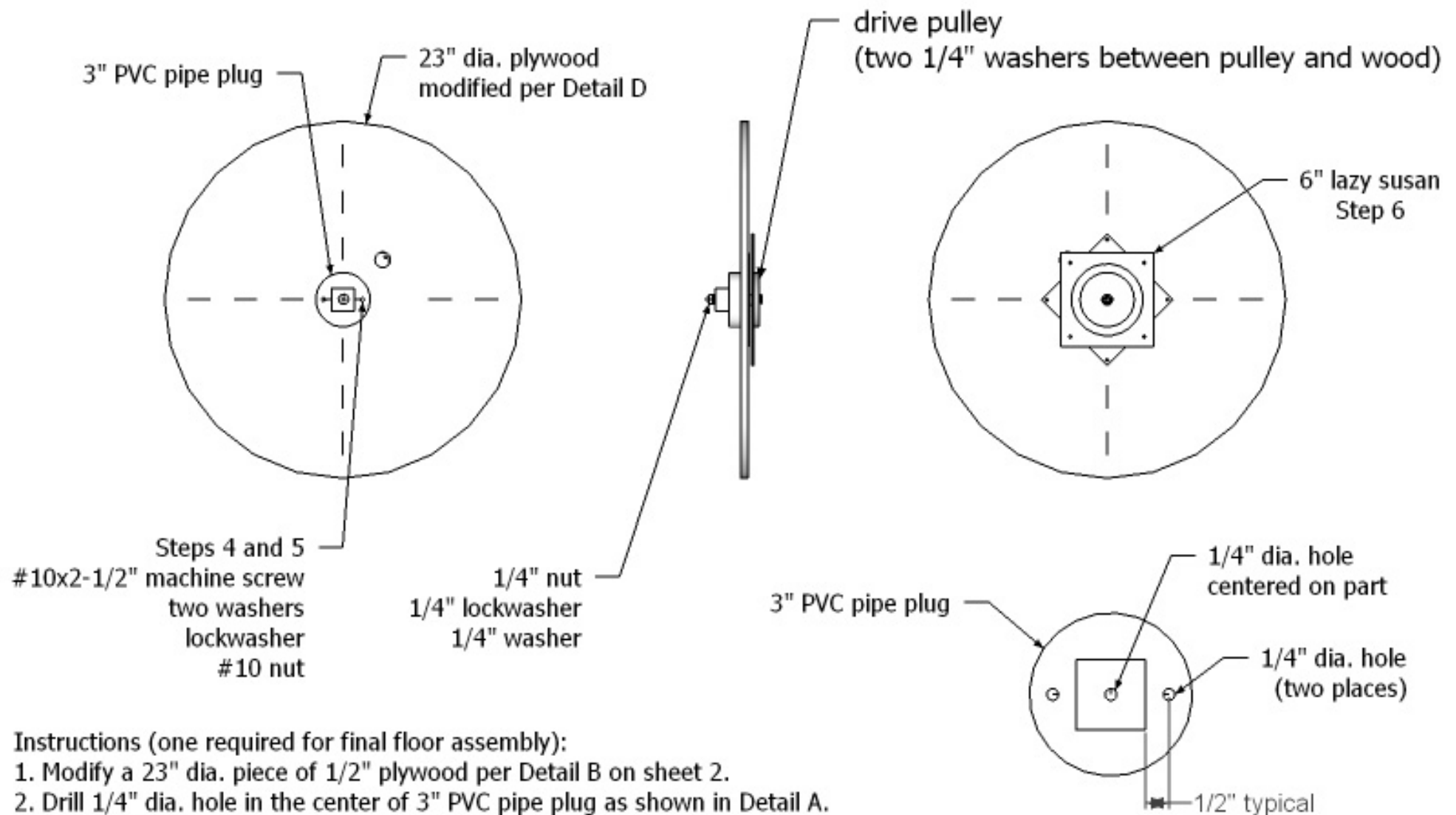
2009EGS-30

Rev

2.0

BEST Robotics Inc.

sheet 1 of 1



Detail A

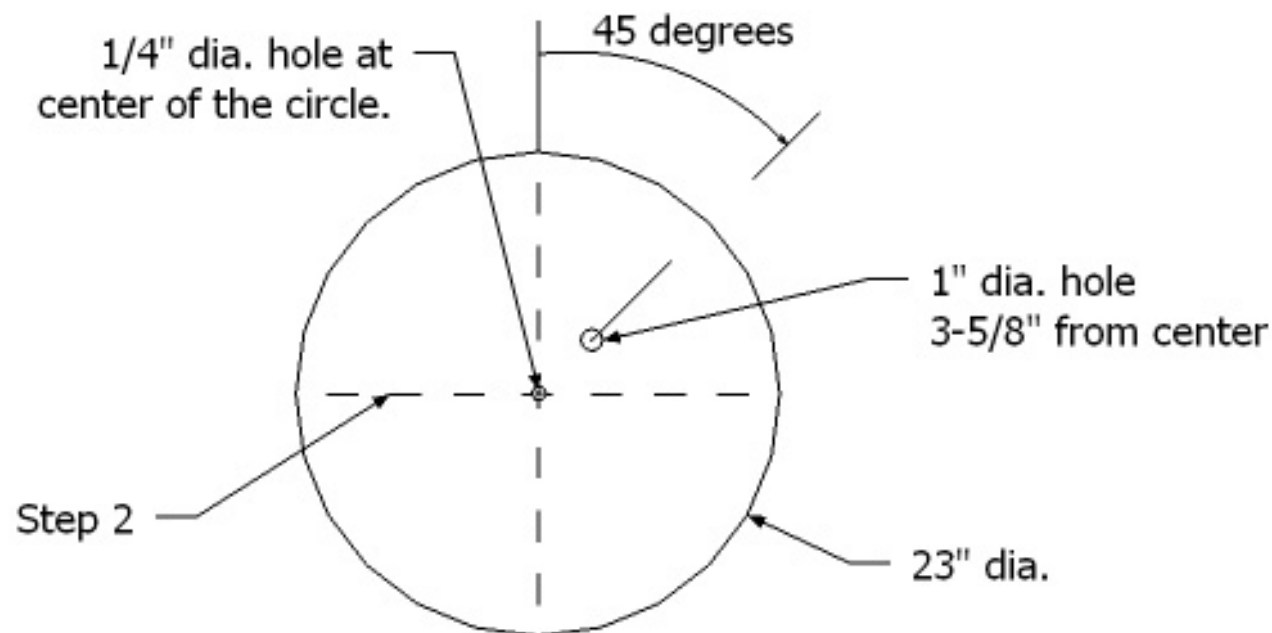
Instructions (one required for final floor assembly):

1. Modify a 23" dia. piece of 1/2" plywood per Detail B on sheet 2.
2. Drill 1/4" dia. hole in the center of 3" PVC pipe plug as shown in Detail A.
3. Install the pipe plug on the top side of the plywood and the drive pulley on the bottom side of the plywood with a single 1/4"x3-1/2" machine screw, lockwasher, nut, and washers as shown. It is important that the collar side of the pulley face the plywood. Tighten the assembly to fully compress the lockwasher.
4. Drill the 1/4" dia. holes through the pipe plug as shown in Detail A. Continue drilling through the plywood and all the way through the pulley.
5. Install #10x2-1/2" machine screw, two washers, lockwasher, and nut in each hole. Overtightening may damage the pulley. Use locktite if necessary.
6. Install lazy Susan by aligning the mounting holes on one flange with the marked diameters. Use four #8x3/4" woodscrews.

Drawn by:
Brazos BEST

scale = 0

Title: EGS Carousel		
Dwg. No. 2009EGS-40		Rev 2.0
BEST Robotics Inc.		sheet 1 of 2



Detail B

Instructions (one required for final floor assembly):

1. Begin with a 23" dia. piece of 1/2" plywood.
2. Carefully mark the exact center and two perpendicular bisecting diameters. Mark the same perpendicular bisecting diameters on both sides of the piece. They will be needed in later operations.
3. Drill a 1" dia. hole 3-5/8" from the center of the part and approx. 45 degrees from the marked diameter.
4. Drill a 1/4" dia. hole in the center of the circle. Take care to drill the hole perpendicular to the face of the part.

Title:

EGS Carousel

Dwg. No.

2009EGS-40

Rev

2.0

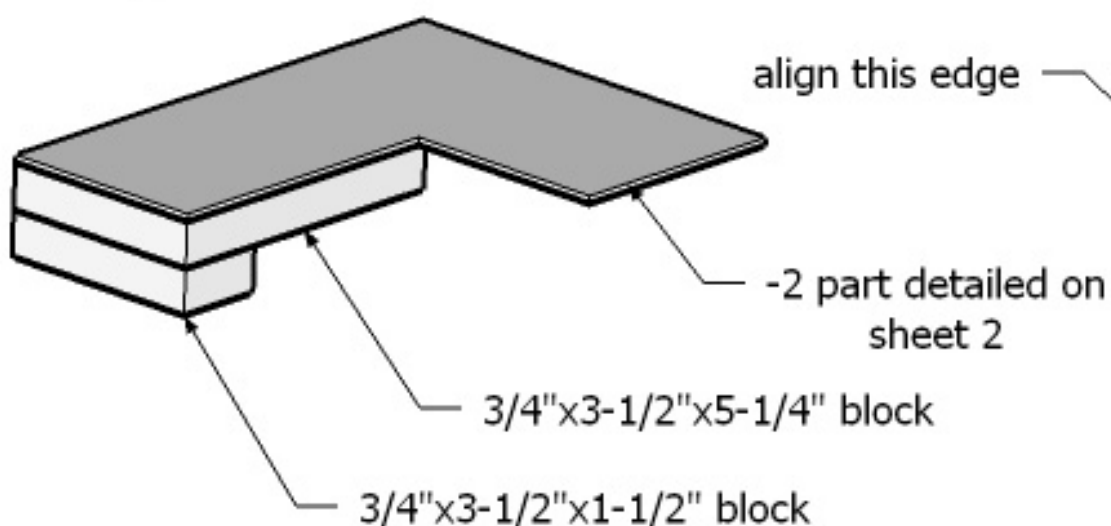
Drawn by:
Brazos BEST

scale = 0

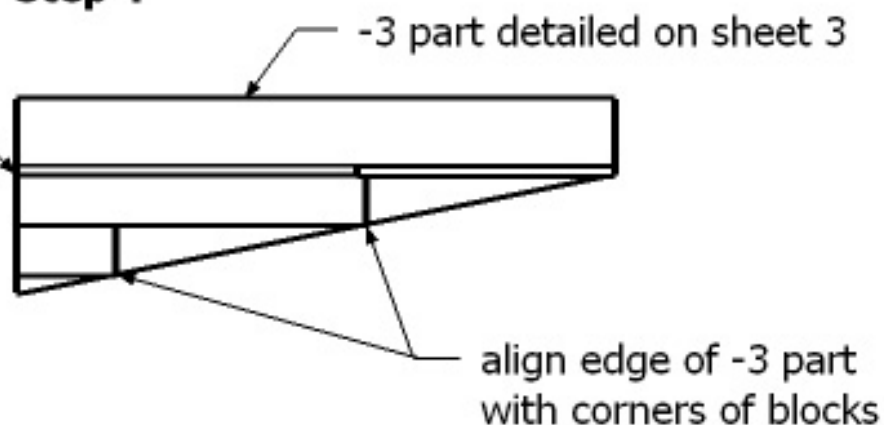
BEST Robotics Inc.

sheet 2 of 2

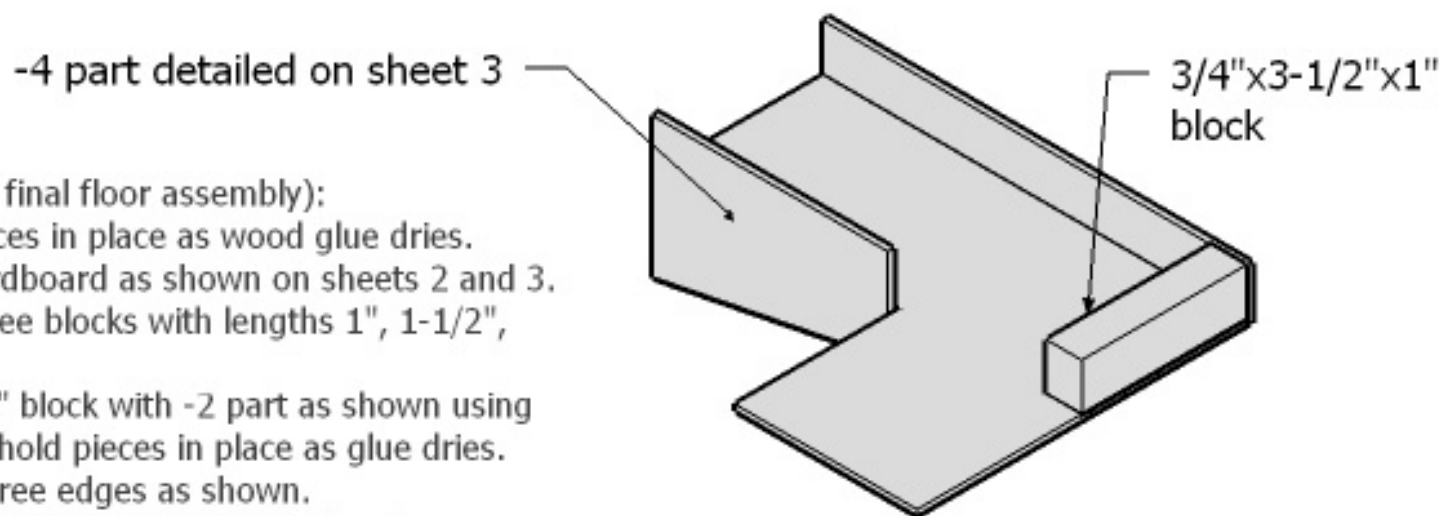
Step 3



Step 4



Steps 5 and 6



Instructions (four units required for final floor assembly):

Small nails may be used to hold pieces in place as wood glue dries.

1. Cut -2, -3, -4 parts from 1/8" hardboard as shown on sheets 2 and 3.
2. From nominal 1x4 lumber cut three blocks with lengths 1", 1-1/2", and 5-1/4".

3. Assemble 1-1/2" block and 5-1/4" block with -2 part as shown using glue. Small nails may be used to hold pieces in place as glue dries.
All three pieces should align on three edges as shown.

4. Install -3 part on far side of the assembly as shown using glue.
Align with the left edge of the assembly and the corners of wood blocks.

5. Install -4 part on near side of assembly as shown using glue.
Align with the left edge of the assembly and the corners of wood blocks.

6. Install 3/4"x1"x3-1/2" wood block as shown using glue.

Title:

EGS Chute

Dwg. No.

2009EGS-50

Rev

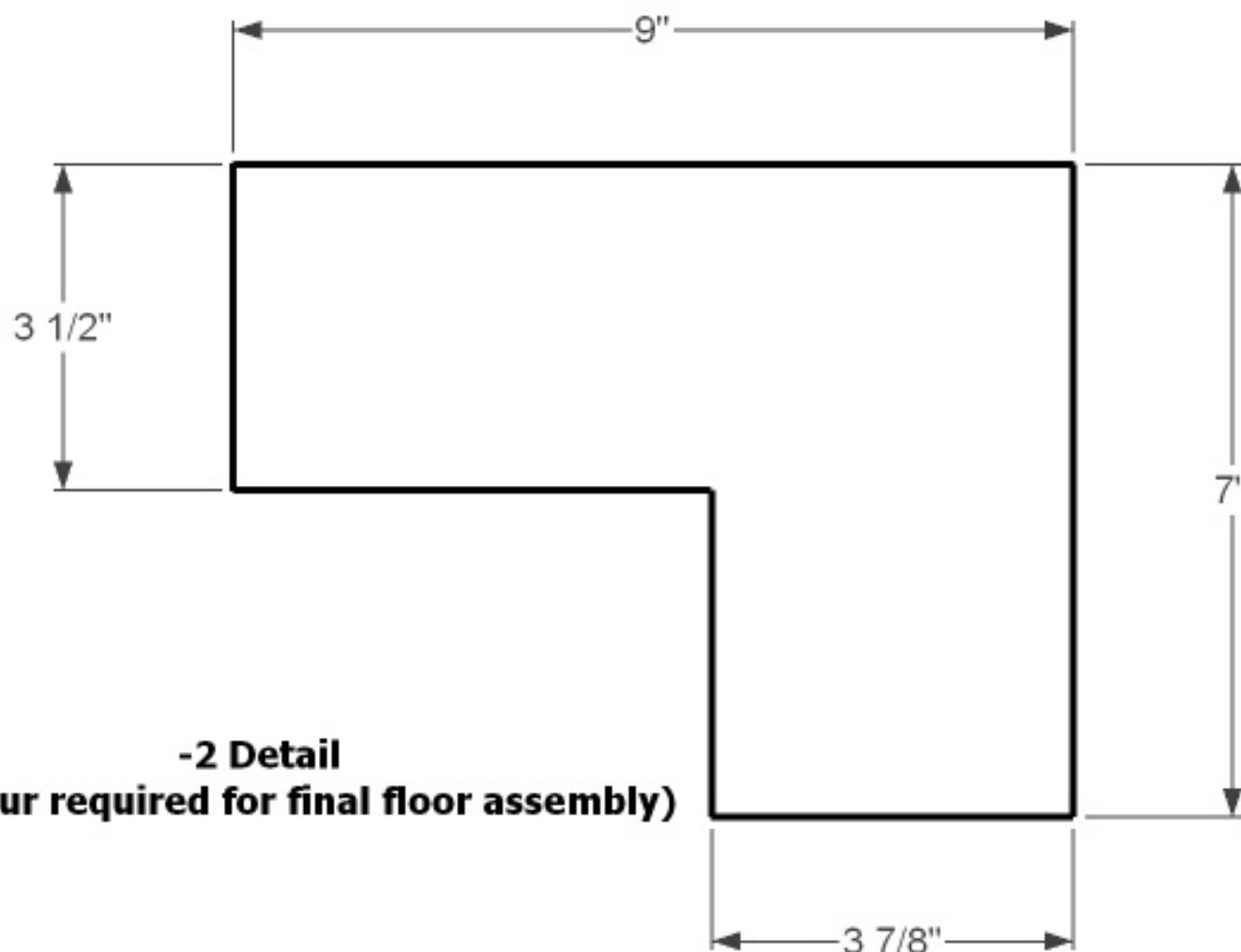
2.0

Drawn by:
Brazos BEST

scale = 0

BEST Robotics Inc.

sheet 1 of 3



-2 Detail
(four required for final floor assembly)

Instructions:

1. Cut part as dimensioned from 1/8" thick hardboard.

Title:

EGS Chute

Dwg. No.

2009EGS-50

Rev

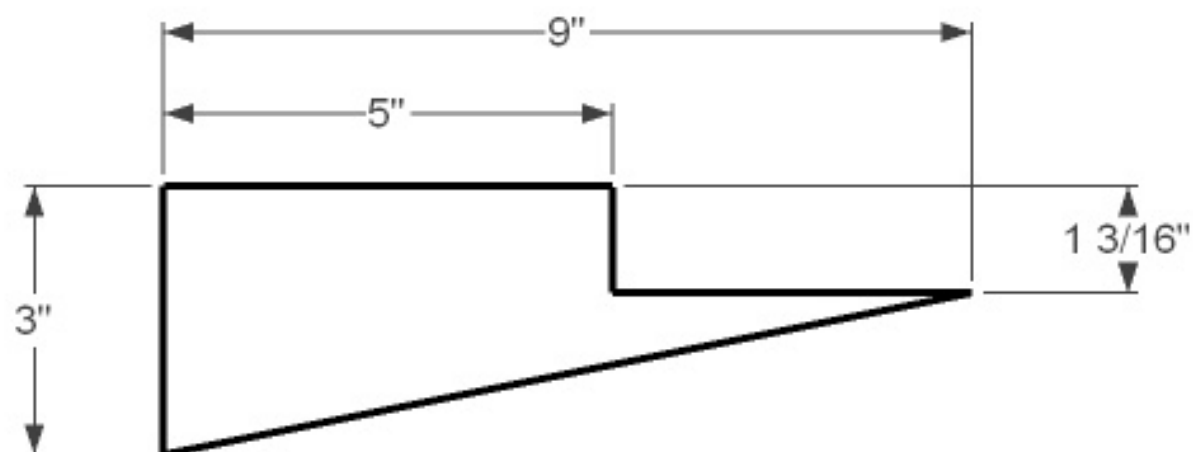
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Drawn by:
Brazos BEST

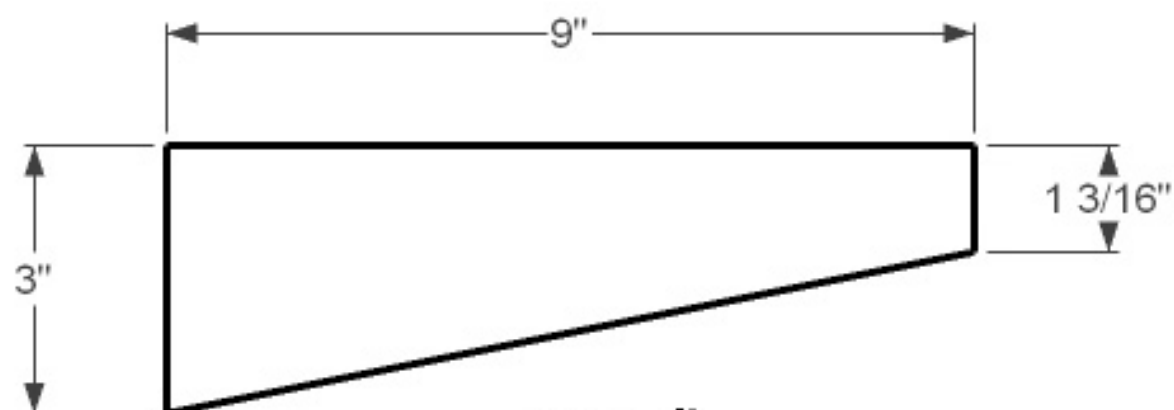
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BEST Robotics Inc.

sheet 2 of 3



-4 Detail
(four required for final floor assembly)

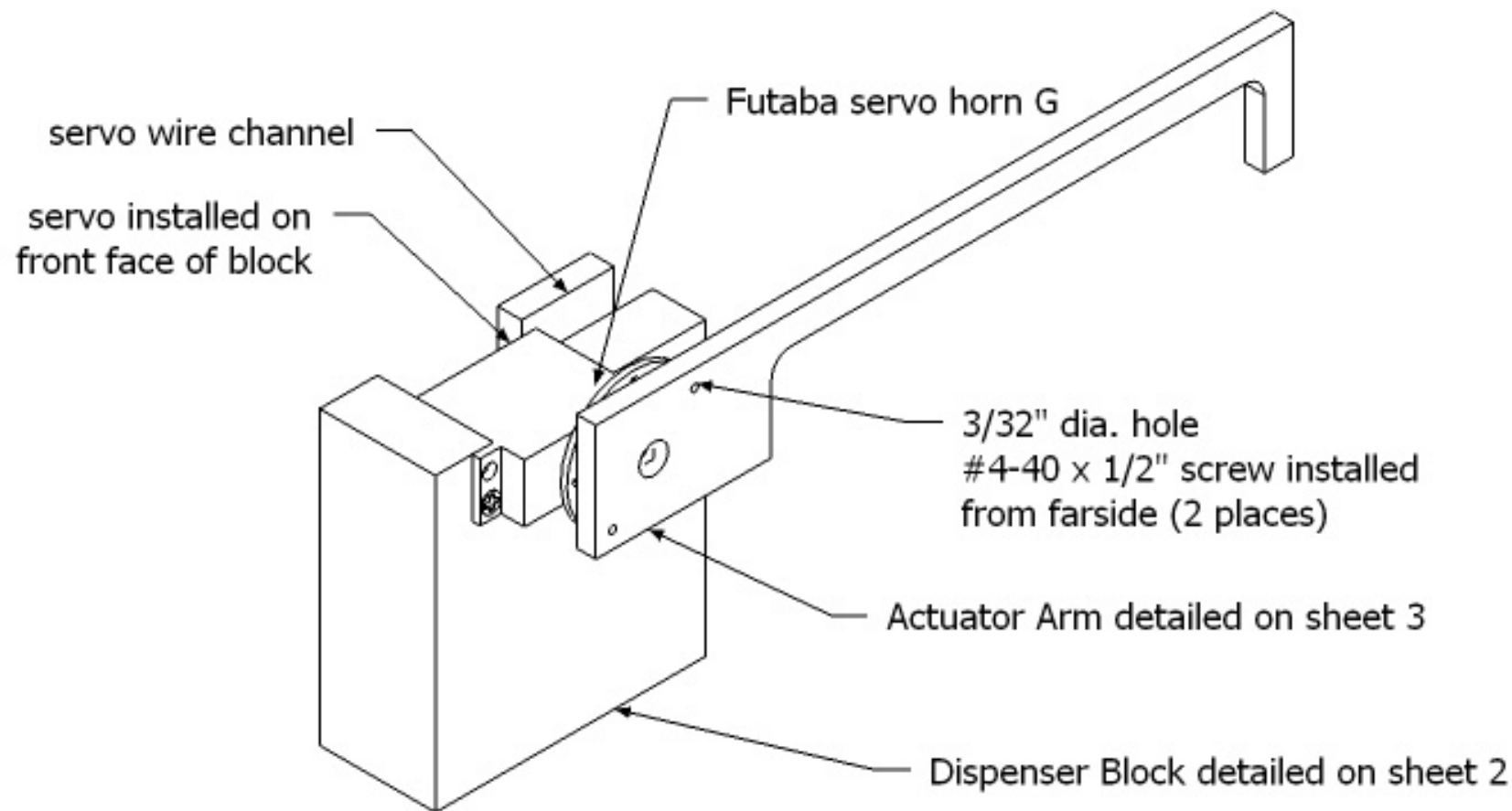


-3 Detail
(four required for final floor assembly)

Instructions

1. Make each part from 1/8" thick hardboard.

Title: EGS Chute		
Dwg. No. 2009EGS-50		Rev 2.0
Drawn by: Brazos BEST	scale = 0	BEST Robotics Inc. sheet 3 of 3



Instructions (four required for final floor assembly):

1. Create 1/4" thick actuator arm as shown on sheet 3 and dispenser block as shown on sheet 2 of this drawing.
2. Install plastic arm on servo horn using 1/2" long #4-40 machine screws through the servo horn and into the plastic arm. Screws should self thread into the holes. If necessary install #4 nuts to secure.
3. Install servo motor on block as shown using two #4x1" wood screw. Precede screw with pilot hole to prevent splitting the wood. The servo wire should run through the servo wire channel.
4. Orient servo horn on servo motor approximately as shown. Secure using servo screw supplied with the servo horn.
5. Final orientation will be determined after testing the working Energy Generating Station.

Drawn by:
Brazos BEST

scale = 0

Title:

EGS Actuator

Dwg. No.

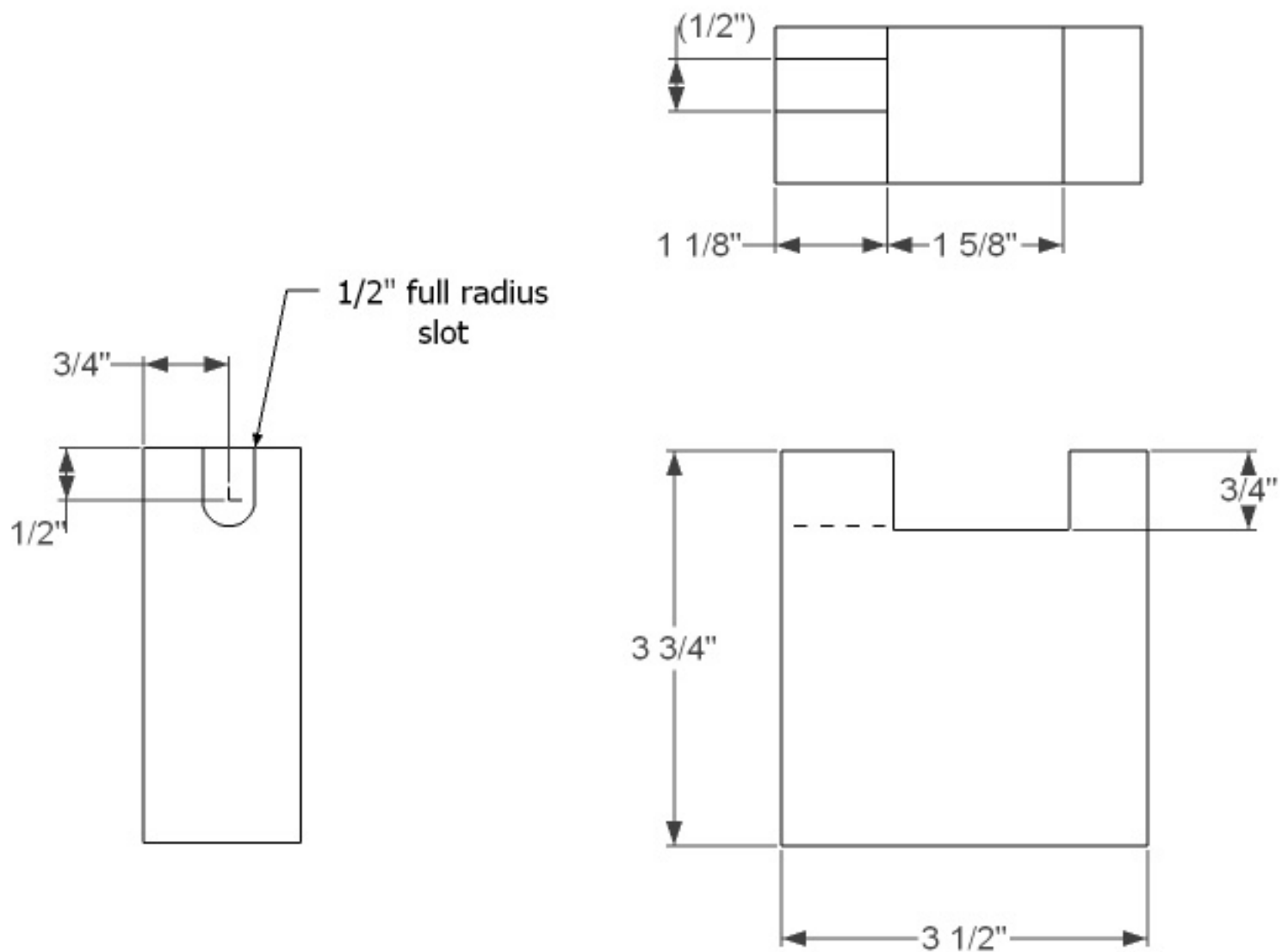
2009EGS-60

Rev

2.0

BEST Robotics Inc.

sheet 1 of 3



Instructions (four required for final floor assembly):

1. Clamp long piece of nominal 2x4 lumber to bench and make 1-5/8" wide slot 3/4" on end using jig saw. Final slot should be a snug fit for servo motor.
2. Cut the piece to 3-3/4" length.
3. Drill 1/2" dia. hole approximately 1-1/2" deep in side of block shown.
3. Using jig saw, extend 1/2" hole to make a slot as shown.

Drawn by:
Brazos BEST

scale = 0

Title:

EGS Actuator

Dwg. No.

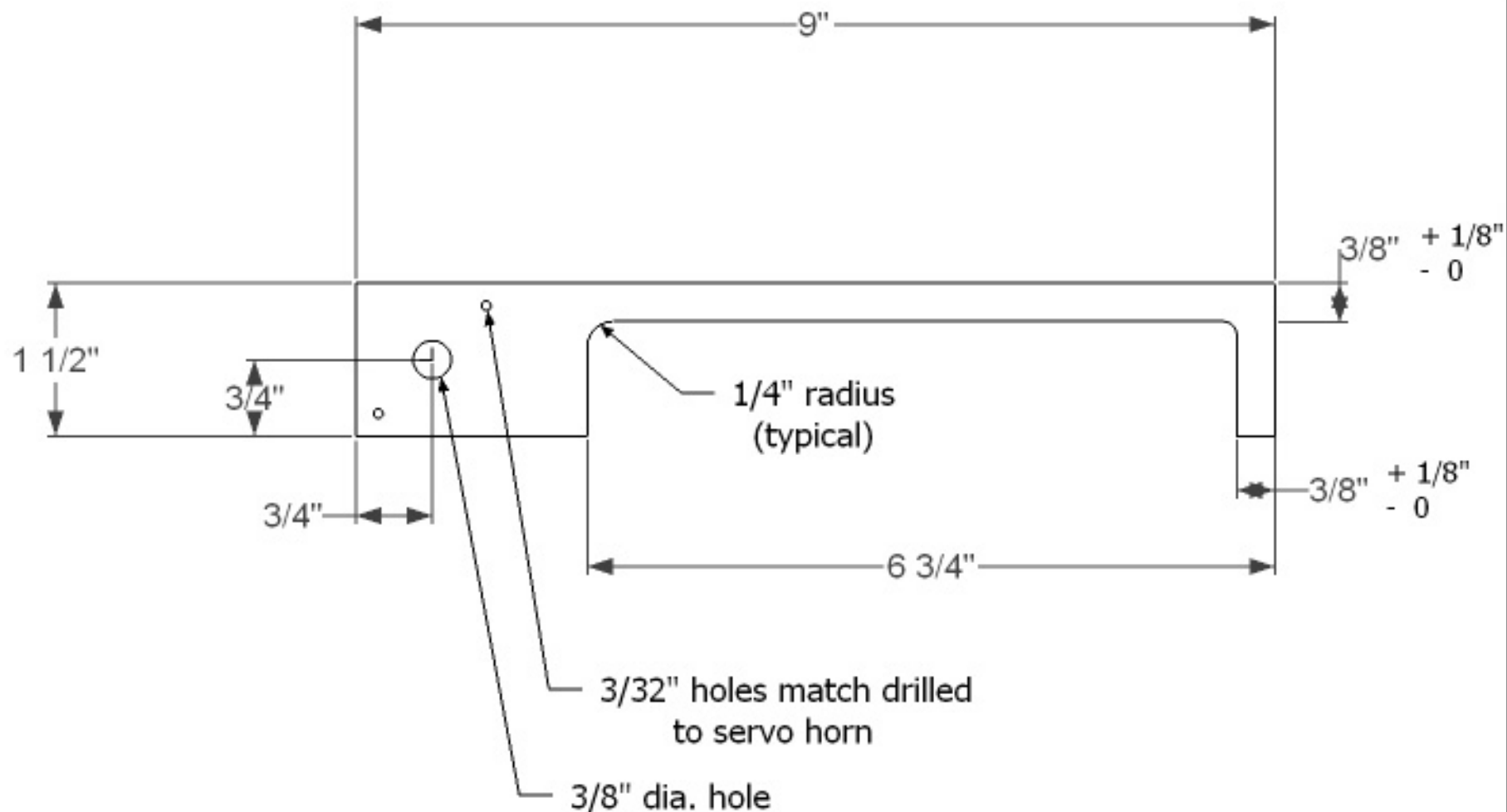
2009EGS-60

Rev

2.0

BEST Robotics Inc.

sheet 2 of 3

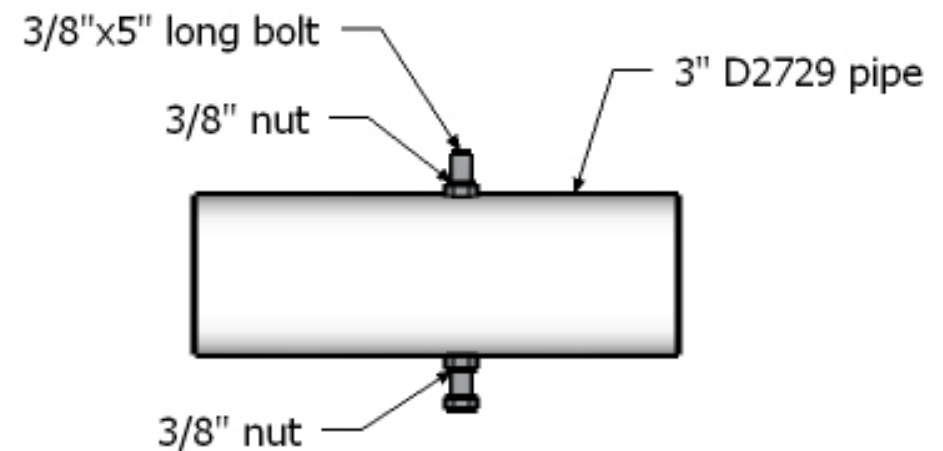
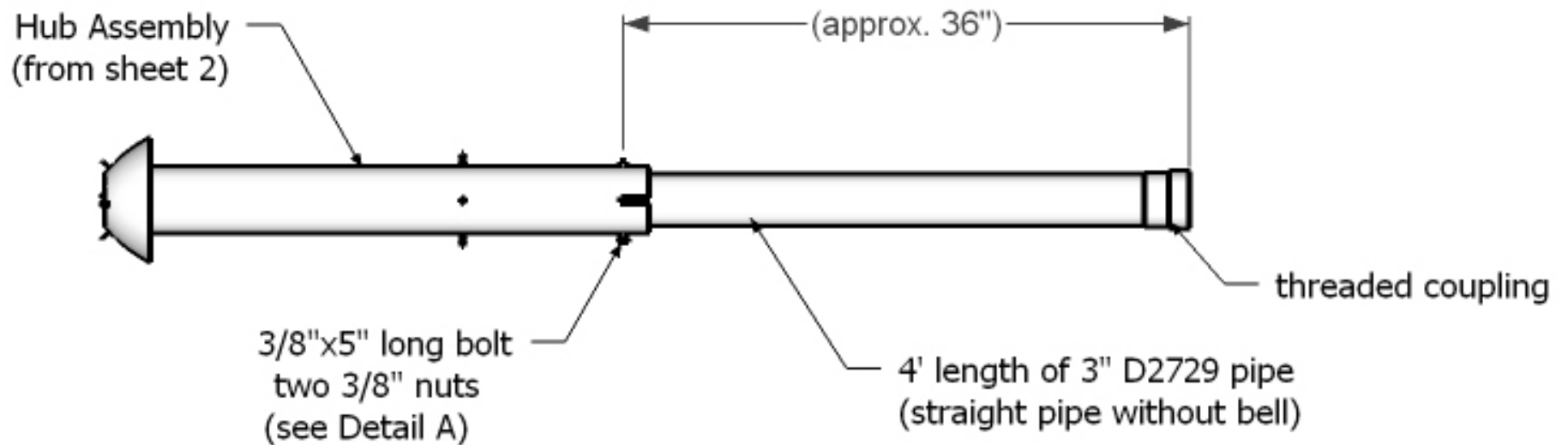


Instructions (four required for final floor assembly):

1. Start with 1-1/2"x9" piece of 1/4" thick plastic.
2. Drill 3/8" hole as shown.
3. Cut remaining geometry using jig saw. Radius shown on corners is not critical.
4. Align piece on servo horn ensuring that access to the servo horn mounting screw is clear. Mark two servo horn hole locations onto the plastic using small drill bit. Drill the holes using 3/32" dia. bit.

Title: EGS Actuator		
Dwg. No. 2009EGS-60		Rev 2.0
scale = 0	BEST Robotics Inc.	sheet 3 of 3

Drawn by:
Brazos BEST



Detail A

Instructions (one required for final field assembly):

1. Begin with 4' length of 3" D2729 Sewer pipe. Install threaded coupling on one end using PVC cement.
2. Drill 3/8" dia. hole through major diameter of pipe approx. 36" from the end of the pipe (the end with the coupling).
3. Install 3/8"x5" carriage bolt in hole and secure with two 3/8" nuts as shown in Detail A. Bolt should extend an equal distance out of both sides of the pipe.
4. Slide Hub Assembly (from sheet 2) onto the pipe until the lagbolt engages the slots at the bottom of the Hub Assembly.

Title:

EGS Tower

Dwg. No.

2009EGS-70

Rev

2.1

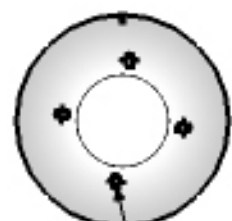
Drawn by:
Brazos BEST

scale = 0

BEST Robotics Inc.

sheet 1 of 2

approx. 8" dia. plastic bowl
(smooth without any lip at all)



woodscrew eyebolt
four equally spaced on
4" dia. circle centered on bowl

Step 3
(see Detail B)

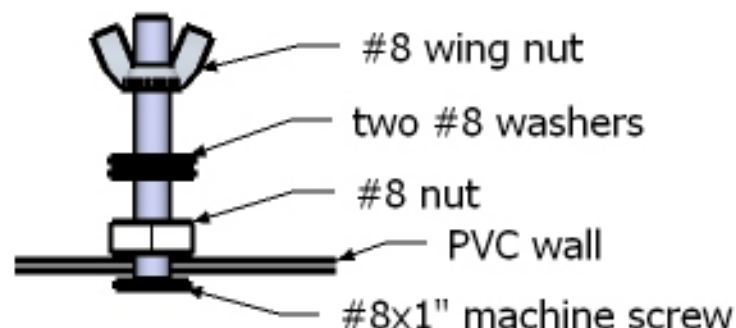


34" length of
4" D2729 sewer pipe

3/8"x2" slot
four equally spaced around pipe

Instructions (one required on final floor assembly):

1. Begin with 34" length of 4" D2729 sewer pipe (with or without a bell).
Using a jig saw cut four slots equally spaced around the perimeter of the pipe as shown. (If the pipe has a bell, then cut the slots in the end WITH the bell).
2. Drill four 3/16" dia. holes equally spaced on the perimeter of the pipe approx. 12" from the end of the pipe.
3. Install hardware per Detail B in each of the four holes. Tighten the nut sufficiently to prevent the screw from vibrating loose over time.
4. Install 4" D2729 endcap (not shown) on opposite end. Do not use PVC cement. Affix the end cap to the pipe using a single #8 woodscrew.
5. Carefully drill four holes equally spaced on a 4" circle centered on the bottom of a 8" dia. bowl (similar to Catalog #: 11010730 at Target.com). Holes should provide loose clearance for woodscrew eyebolt.
6. Center plastic bowl on PVC endcap. Use clearance holes to matchdrill pilot holes in the PVC endcap.
7. Install woodscrew eyebolts through the bowl and into the PVC cap. The eyebolts should NOT apply any pressure to the bowl. Rather, the bowl should rest freely atop the endcap.



Detail B

Drawn by:
Brazos BEST

scale = 0

Title:

EGS Tower

Dwg. No.

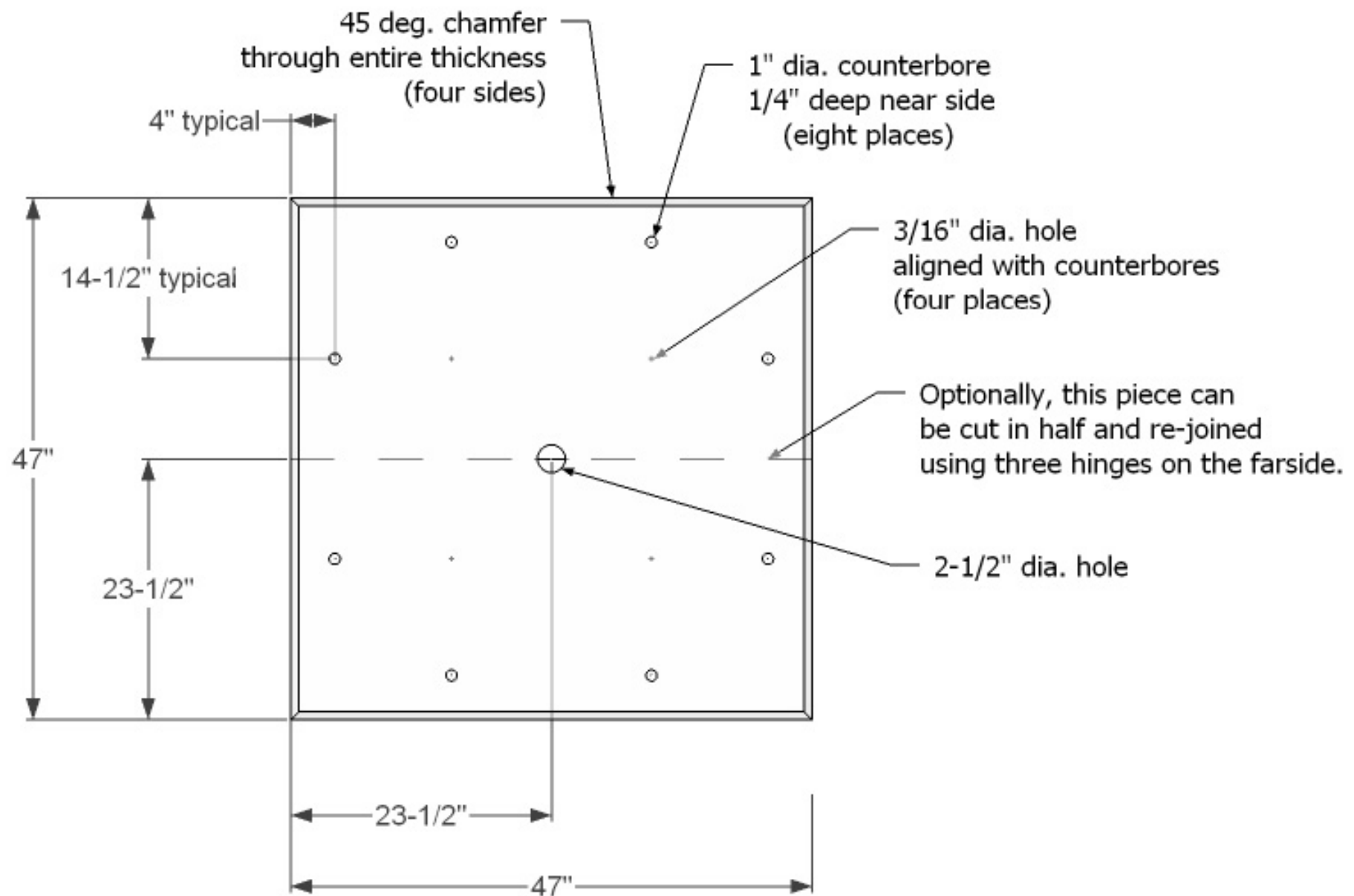
2009EGS-70

Rev

2.1

BEST Robotics Inc.

sheet 2 of 2



Instructions:

1. Start with 4' square piece of 3/4" plywood.
2. Chamfer edges of square using table saw or circular saw with an edge guide while removing approx. 1/2" width from each side.
3. Drill counterbores using 1" spade bit located as shown.
4. Drill 3/16" dia. through holes located as shown.
5. Cut 2-1/2" dia. hole in center of piece using a hole saw.
6. (Optional) Cut in half and rejoin using hinges on bottom side.

Title:

EGS Base

Dwg. No.

2009EGS-80

Rev

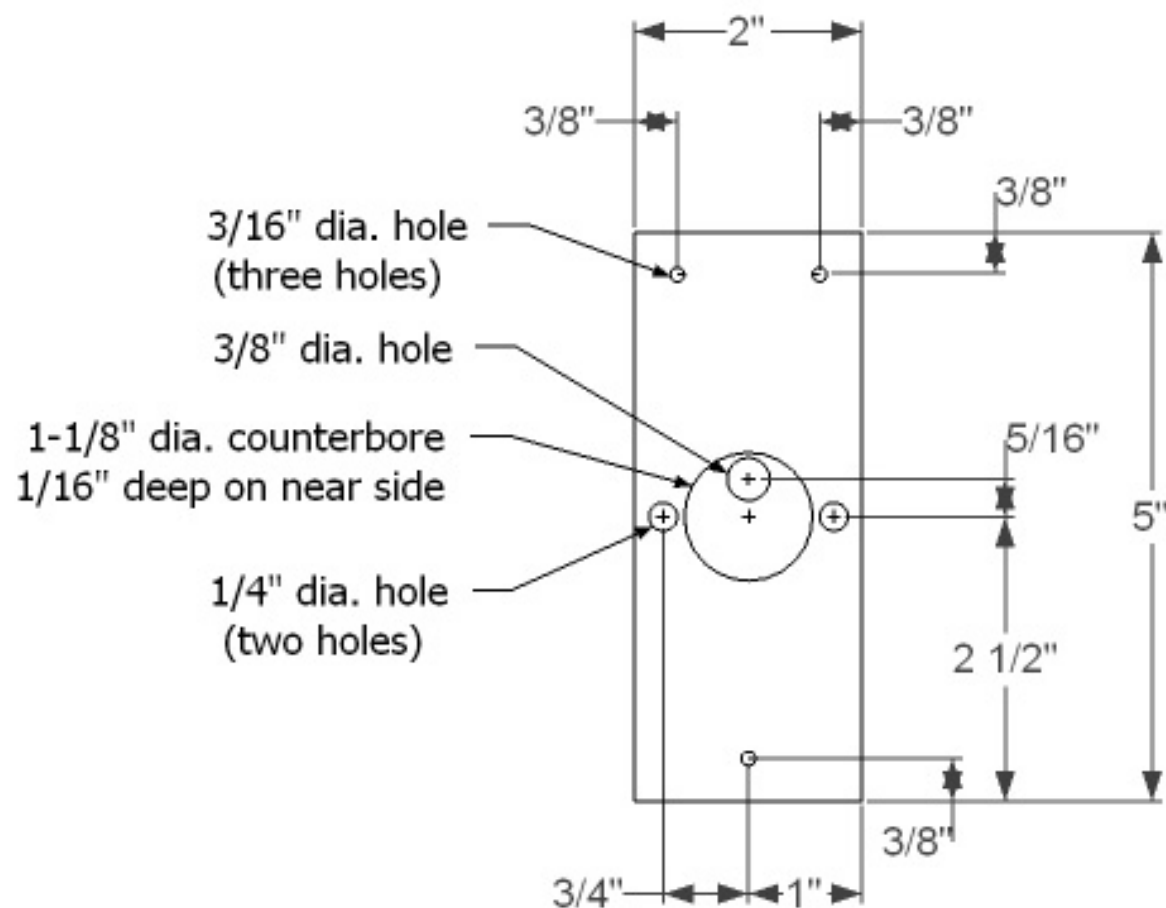
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Drawn by:
Brazos BEST

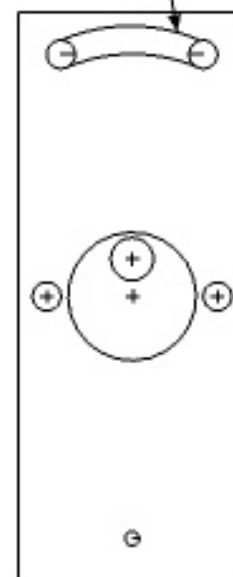
scale = 0

BEST Robotics Inc.

sheet 1 of 1



1/4" full radius slot
arc centered on bottom
3/16" dia. hole



Alternative Configuration

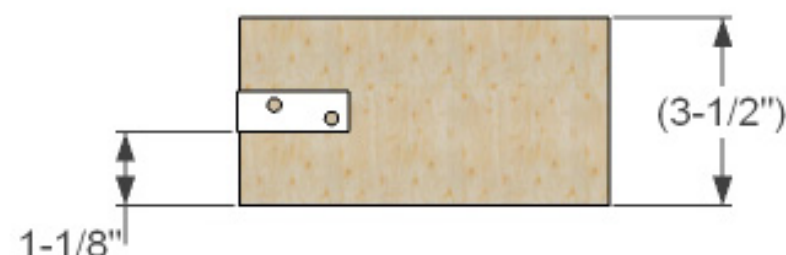
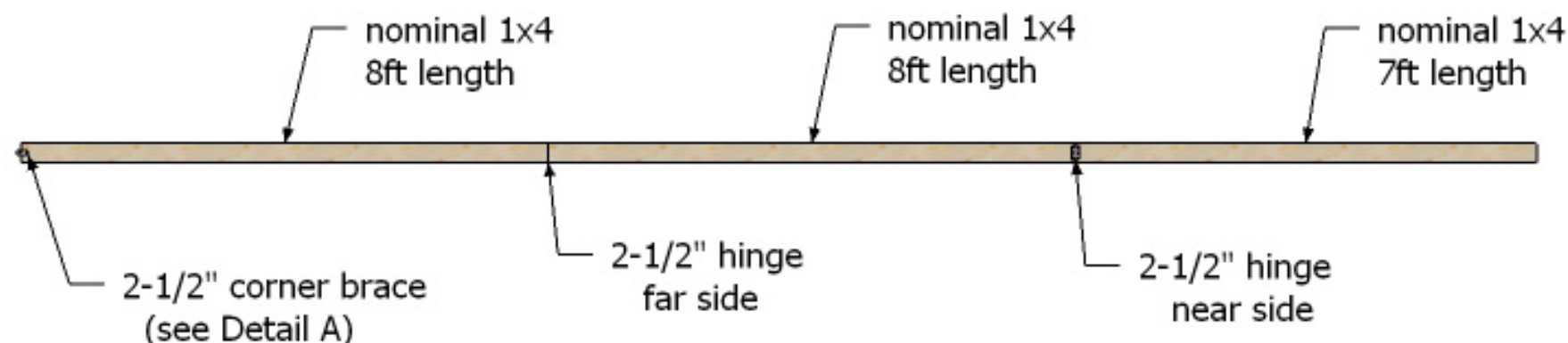
Instructions (one required for final floor assembly):

1. Begin with 1/4" plastic cut to 2"x5".
2. Drill three 3/16" dia. holes through the part located approx. as shown.
3. Locate and drill counterbore using Forsner bit. Note that it is centered on the part.
4. Locate and drill remaining holes relative to center of counterbore as shown. Note that the two 1/4" dia. holes are located approx. 1-1/2" apart and aligned horizontally with the center of the counterbore. The 3/8" dia. hole is aligned vertically with the center of the counterbore.
5. (optional for spring-tensioned drive system) Replace upper 3/16" dia. holes with 1/4" dia. holes. Using a jig saw, extend the holes in an arched slot centered on the remaining 3/16" dia. hole near the bottom of the part.

Drawn by:
Brazos BEST

scale = 0

Title: EGS Motor Mount		
Dwg. No. 2009EGS-90		Rev 1.1
BEST Robotics Inc.		sheet 1 of 1



Detail A

Instructions (four required for final floor assembly):

1. Lay three lengths (8ft, 8ft, 7ft) of nominal 1x4 lumber end to end.
2. Install 2-1/2" hinges at each joint as shown using #8x3/4" long screws.
3. Locate the 2-1/2" corner brace flush to the end as shown in Detail A.
Secure the angle bracket using a two #8x3/4" screws.
4. Install a plywood stiffener at each joint (not shown). Use 3/8"x3-1/2"x11-7/8" piece of plywood. Center the stiffener on the opposite side from each hinge. Affix with two #8x1" woodscrews into each piece of 1x4 lumber. Preceed screws with clearance holes and pilot holes to close gaps and prevent splitting. (screws can be removed from one 1x4 to allow the assembly to fold for easy storage)

Drawn by:
Brazos BEST

scale = 0

Title:

Floor Perimeter Wall

Dwg. No.

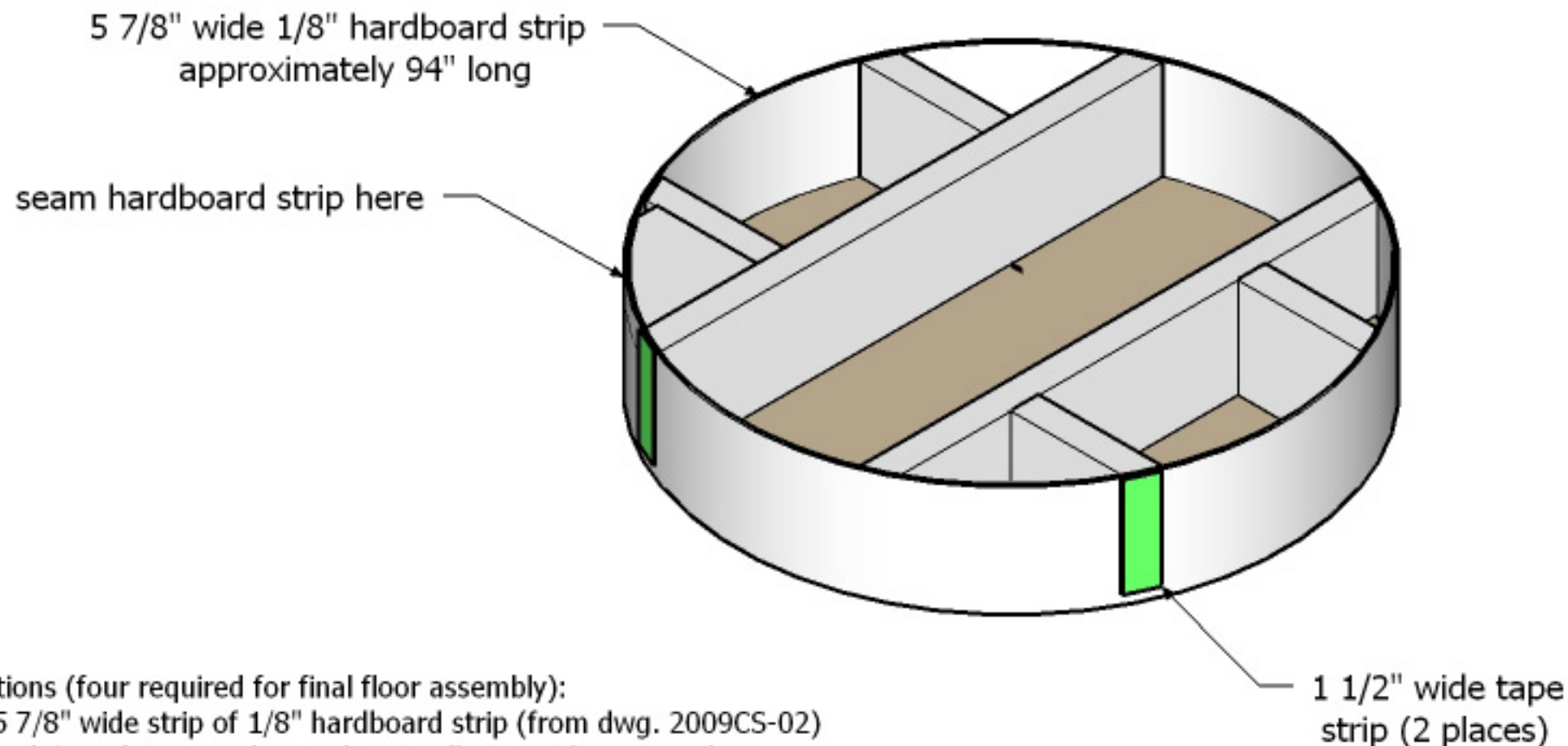
2009FPW-00

Rev

2.0

BEST Robotics Inc.

sheet 1 of 1



Instructions (four required for final floor assembly):

1. Cut 5 7/8" wide strip of 1/8" hardboard strip (from dwg. 2009CS-02) to length in order to produce only a small gap at the seam when wrapped around the assembly (approximate length is 94").
2. Install strip by aligning with plywood circle such that small fasteners can be installed into the plywood around the entire circumference. If the assembly is resting on the floor as shown, then the strip edge should also rest on the floor.
3. Short fasteners (3/4"-1" long) should be installed through the hardboard into every 2x6 piece. Large headed nails or washers are required to prevent tearing. Glue is recommended.
4. Install two tape strips as shown in order to indicate the exact location of these specific 2x6 braces. They will later be used to anchor the assembly to the field perimeter.

Drawn by:
Brazos BEST

scale = 0

Title:

Operator Platform

Dwg. No.

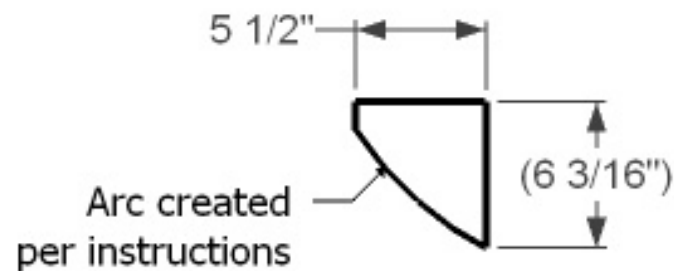
2009OP-00

Rev

1.0

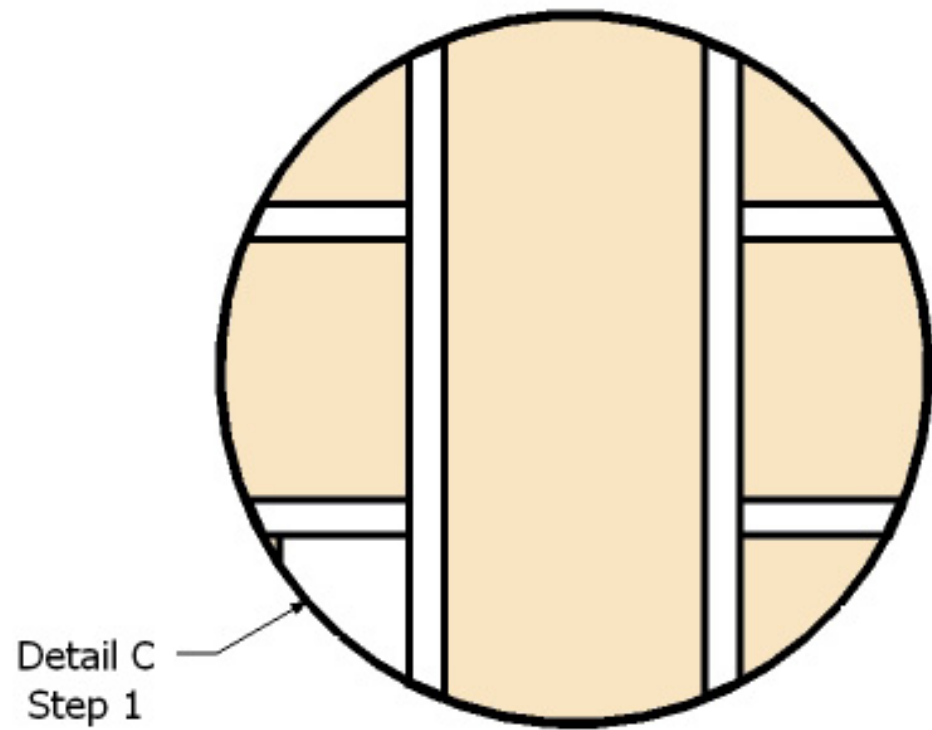
BEST Robotics Inc.

sheet 1 of 3

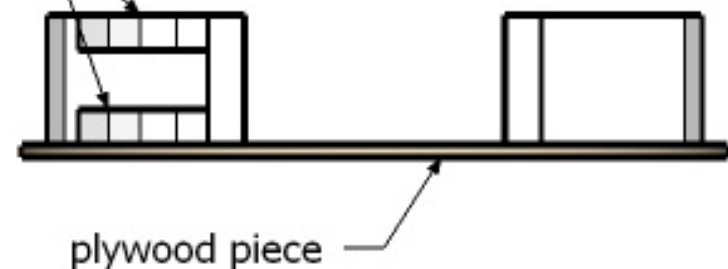


Detail C

(made from nominal 2x6 lumber)
(two required for each unit)



Detail C
Step 3



Instructions (four required for final floor assembly):

Begin with the assembly from sheet 3 with the plywood facing down.

1. Position 7" long piece of nominal 2x6 lumber in corner of assembly as indicated.
2. Trace the curve of the plywood circle onto the 2x6 piece and cut resulting arc with a jigsaw or bandsaw to create piece shown in Detail C. Make two. Do NOT use these pieces as a template for the other operator platforms. Rather, each piece should be custom fit to its respective assembly.
3. Position cut pieces as shown in front view and affix to existing 2x6 pieces using 3" fasteners. Precede with pilot holes and clearance holes as necessary to close gaps and prevent splitting.

Title:

Operator Platform

Dwg. No.

2009OP-00

Rev

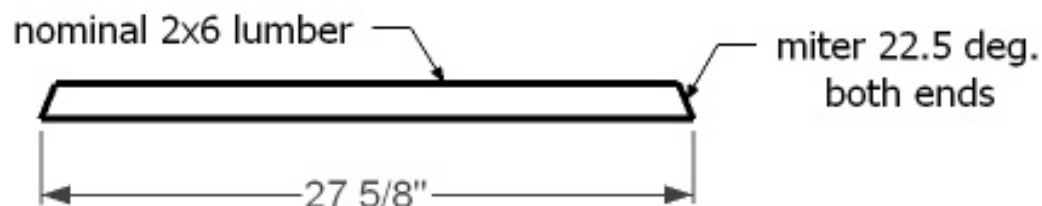
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Drawn by:
Brazos BEST

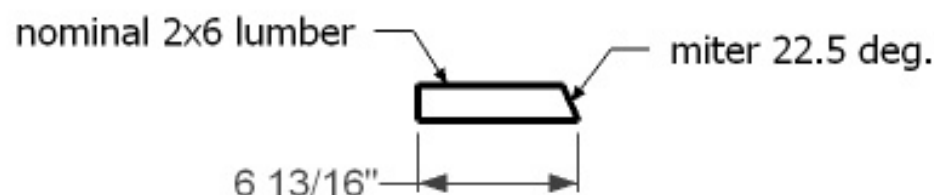
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BEST Robotics Inc.

sheet 2 of 3



Detail A
(two required for part)

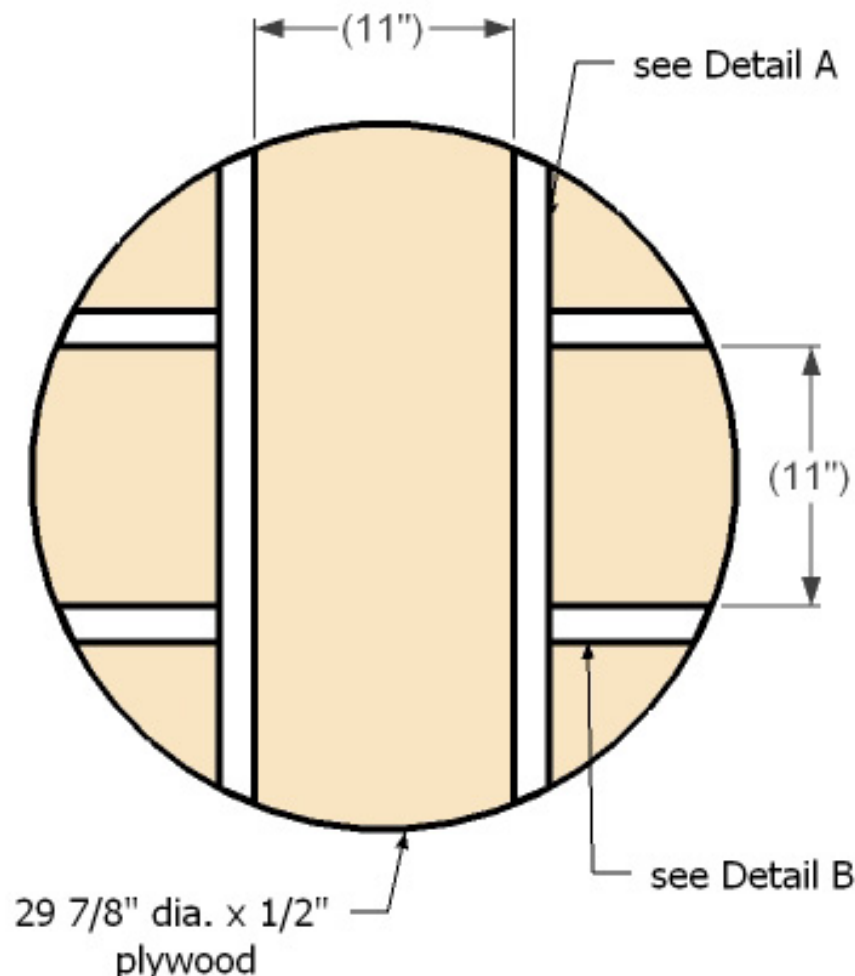


Detail B
(four required for part)

Instructions (four required for final floor assembly):

Glue should be added to each joint as pieces are positioned.

1. Cut nominal 2x6 lumber as dimensioned in Detail-A and Detail-B.
2. Position one of the Detail-A pieces to form a chord on the plywood circle. It is important that each end of the 2x6 piece align with the edge of the plywood without extending over it. Temporarily affix in place by clamping or brad nailing.
3. Position second Detail-A piece parallel to the first and align with edge of plywood. Temporarily affix in place.
4. Position each of the Detail B pieces as shown. In each case, ensure that the piece aligns with the edge of the plywood and abutts the Detail-A piece.
5. Install 3" fasteners at each union between Detail-A and Detail-B pieces. Each joint should have two fasteners passing through Detail-A and into Detail-B. Precede with pilot holes and clearance holes as necessary to close gaps and prevent splitting.
6. Carefully turn the entire assembly over and install 1 1/2" fasteners through the plywood and into each 2x6 piece.



Title:

Operator Platform

Dwg. No.

2009OP-00

Rev

1.0

Drawn by:
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scale = 0

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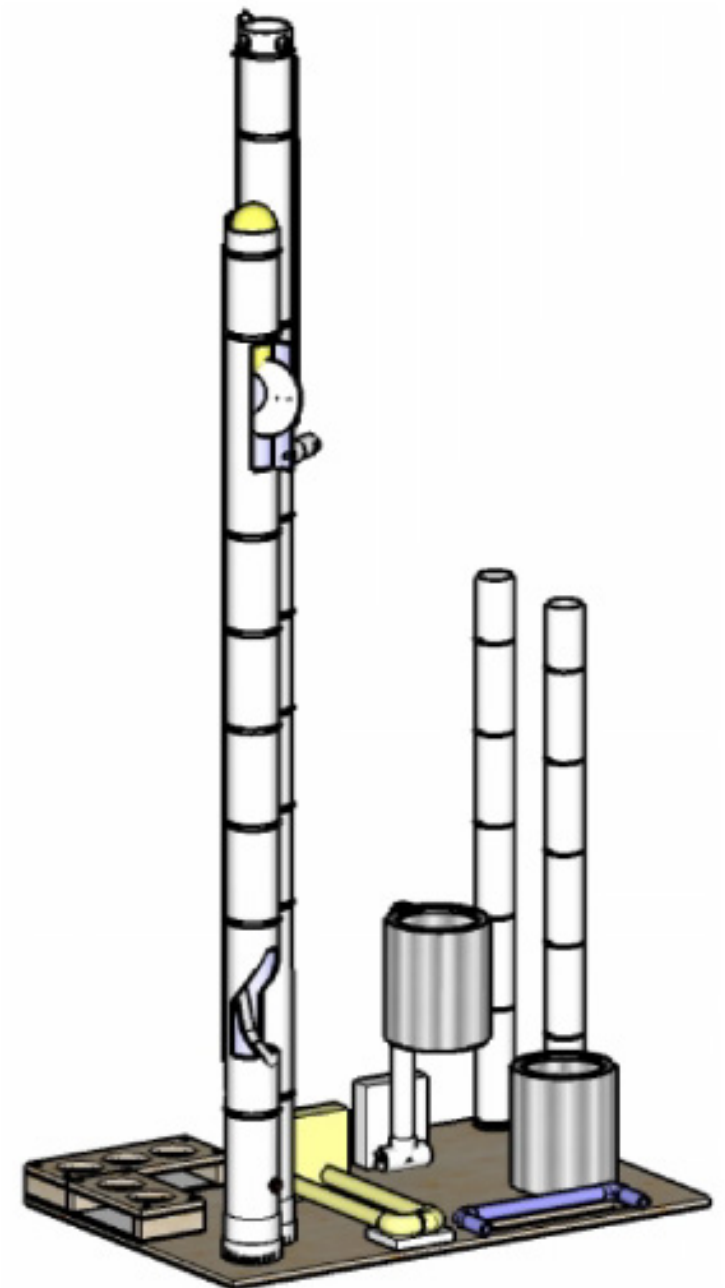
sheet 3 of 3

Instructions (four required for final floor assembly):

Reference sheet 2 for precise locations of each part.

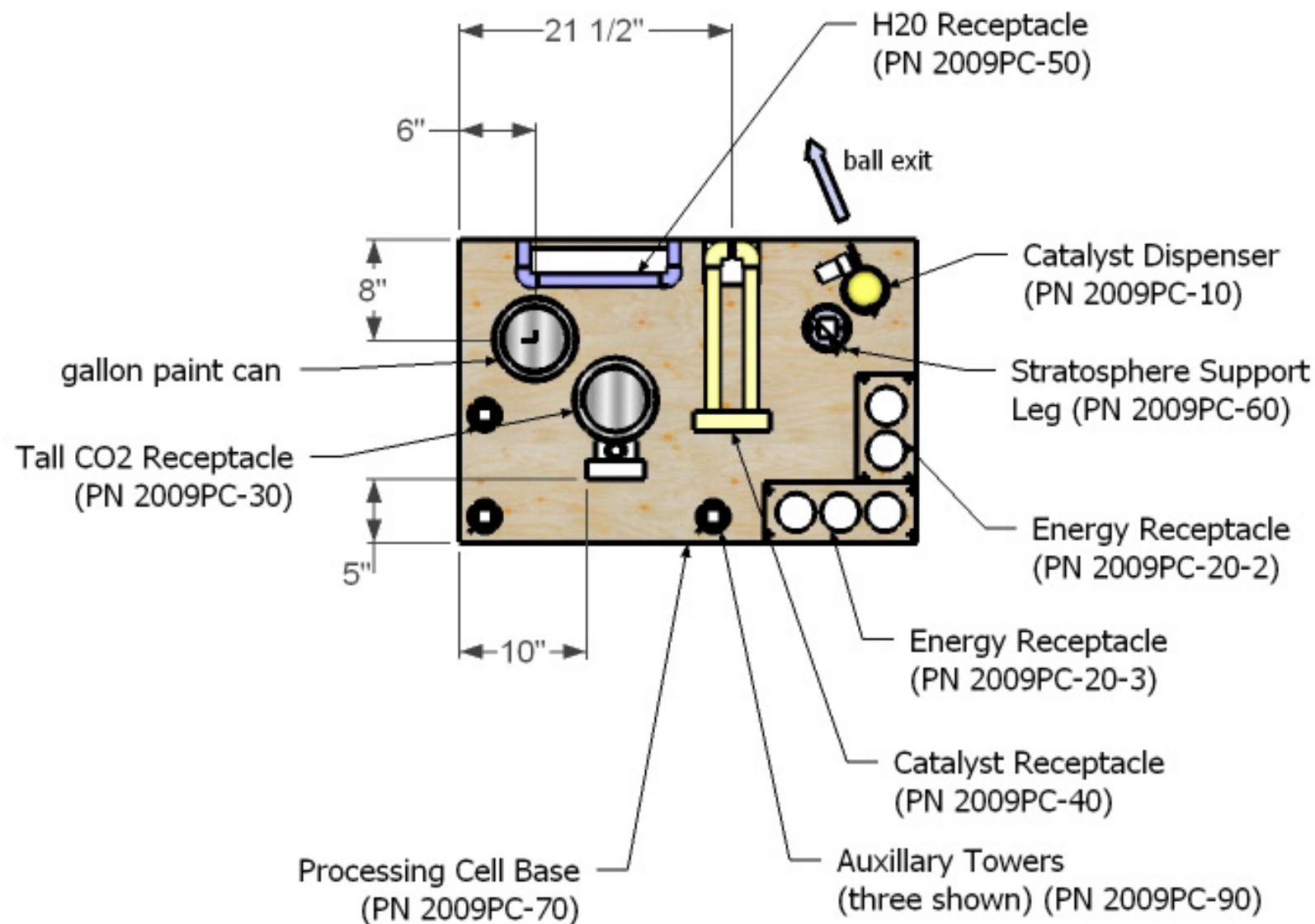
In each case, screws should be preceded with clearance holes through the Processing Cell Base and pilot holes in the relieving piece.

1. Locate Energy Receptacles as shown, abutting each other and aligned with edges of Processing Cell Base.
2. Mount each Energy Receptacle using two #8x1-1/2" woodscrews through the Processing Cell Base and into the 1x2 material in the Energy Receptacle.
3. Mount the H2O Receptacle around the cutout as shown, aligned with the front of the Processing Cell Base, using two #8x1-1/2" woodscrews through the Processing Cell Base and into the PVC elbows.
4. Drill 3/16" dia. hole in center of bottom of gallon paint can.
5. Install can as shown using #8x1" machine screw, washer, and wingnut.
A 3/16" dia. hole is required in the base. A 1/2" dia. counterbore by 1/8" deep should be drilled on bottom side of the base to sink the screw head.
6. Locate the Tall CO2 Receptacle as shown and affix with two #8x1-1/2" woodscrews through the Processing Cell Base and into the 2x6 block.
7. Locate the Catalyst Receptacle as shown, aligned with edge of Processing Cell Base and affix with two #8x1-1/2" woodscrews through the Processing Cell Base and into the 2x6 block.
8. Apply dry bar soap to threads on PVC pipe plugs to lubricate threads.
9. Loosely thread the Catalyst Dispenser onto the indicated PVC pipe plug until ball exit chute is roughly aligned with arrow shown.
10. Loosely thread the Stratosphere Support Leg onto the indicated PVC pipe plug.
11. Loosely thread the three Auxillary Towers onto their respective PVC pipe plugs.
The exact length of tower in each location is not important. Various heights can be mixed for aesthetics.



Title: Processing Cell		
Dwg. No. 2009PC-00		Rev 1.0
scale = 0	BEST Robotics Inc.	sheet 1 of 2

Drawn by:
Brazos BEST



Title:

Processing Cell Assembly

Dwg. No.

2009PC-00

Rev

1.0

Drawn by:
Brazos BEST

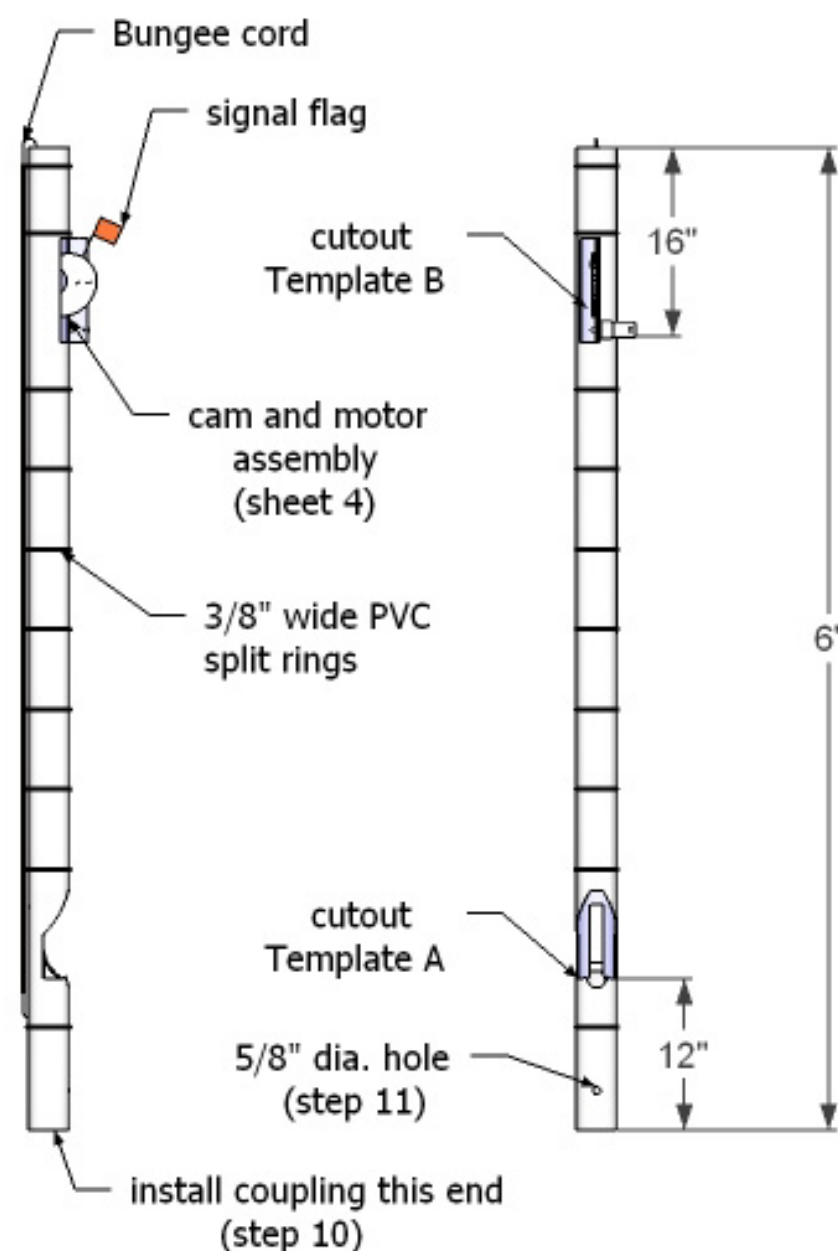
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BEST Robotics Inc.

sheet 2 of 2

Instructions (four required for final floor assembly):

1. Create a 6' length of 3" D2729 sewer pipe by joining a 36" length with a 40" length (with one piece having a flared coupling end) and then cutting to length. Do NOT apply PVC cement to the joint, it must be adjustable later.
2. Print Template A (sheet 2) and Template B (sheet 3) to scale. If printed on cardstock, then a single copy can be reused to create the four required parts.
3. Follow instructions on sheet 2 for lower cutout using Template A.
4. Follow instructions on sheet 3 for upper cutout and motor flap using Template B.
5. Install motor per Detail C using three #4-40 screws (approx. 3/8" long) and three #4 washers. Enlarge holes in PVC motor-flap as necessary to engage all three screws.
6. Attach 6' length of 2-conductor wire to motor and run it down the backside of the pipe. Secure in place with white tape.
7. (optional) Cut seven to ten 3/8" wide PVC rings from scrap 3" pipe. Snip each ring with wire cutters to create a split ring that can be spread apart and snapped onto the Dispenser pipe. Install at 6"-10" intervals as desired to mimic seems on a refinery smokestack. Tape in place if necessary.
8. Drill one 3/8" dia. hole on backside of pipe BELOW the exit chute. Install 36" (freelength) bungee cord by inserting one hook into the hole and the other hook over the top edge of the pipe.
9. Install Cam (PN 2009PC-12) and motor hub (PN 2009PC-11) following instructions on sheet 4.
10. Install 3" threaded PVC coupling (not shown) to bottom end of pipe using PVC cement.
11. Drill 5/8" dia. hole through both walls of pipe 5" from bottom of assembly directly below the exit chute.
12. Solder 6" pigtail (2-conductor wire) to pushbutton and install the pushbutton in the whole directly under the exit chute. It may be helpful to heat the area with a heat gun.
13. Fish the pigtail out the hole on the backside of the pipe and tape in place for future use.
14. Cut the wire on a marking flag to approx. 7". Insert in tight 1-1/2" deep pilot hole drilled in edge of cam such that flag is verticle when ball is released.



Title:

Catalyst Dispenser

Dwg. No.

2009PC-10

Rev

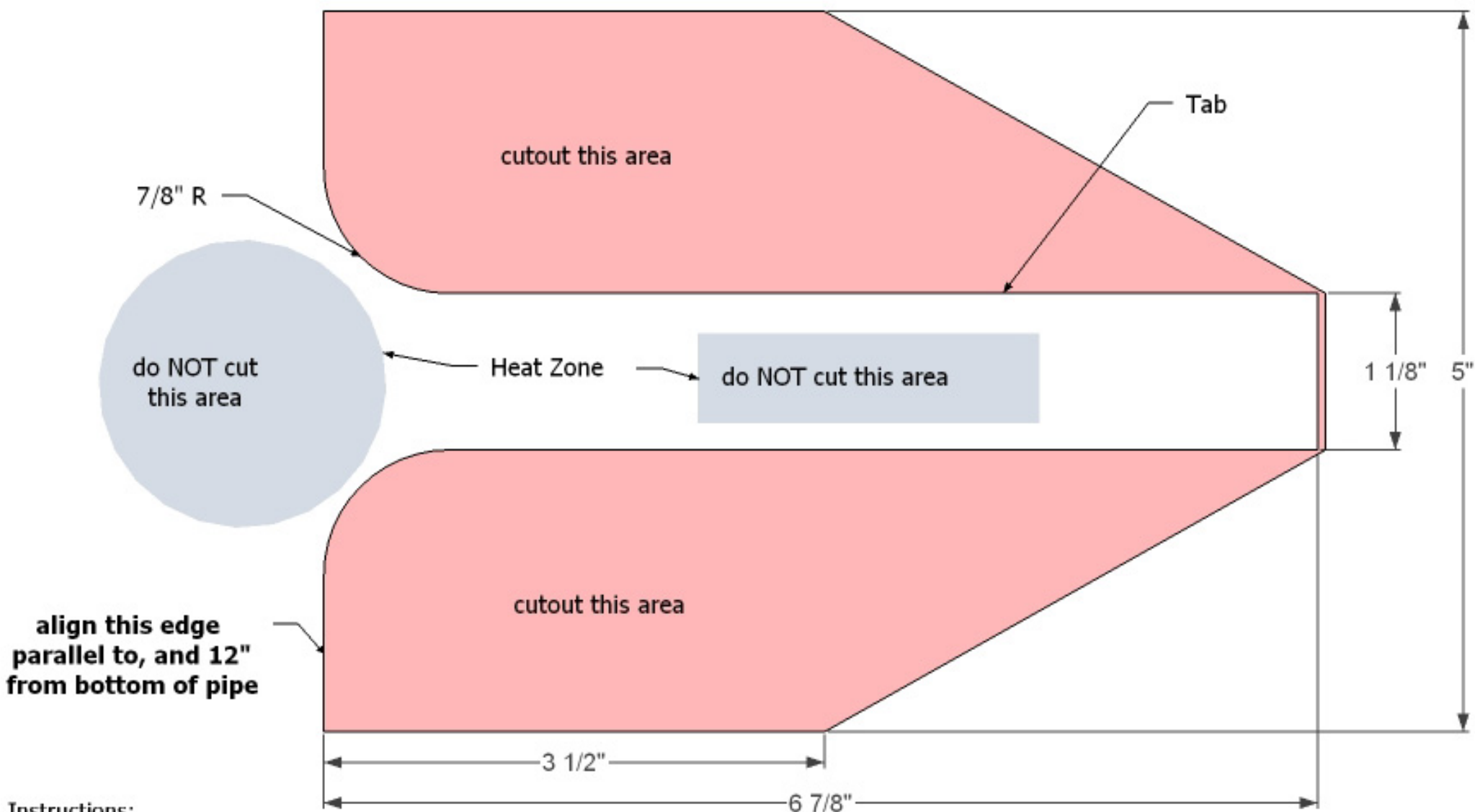
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Drawn by:
Brazos BEST

scale = 0

BEST Robotics Inc.

sheet 1 of 4



Template A

Instructions:

1. Print this page to scale on cardstock paper. Position 12" above base of pipe with longitudinal axis of template aligned to longitudinal centerline of pipe.
2. Transfer outline to pipe and cut all outlines with a jigsaw.
Do NOT cut along the dimension lines. Do NOT cut the Heat Zone.
3. Lay the pipe on a level surface with the cutout facing up.
4. Using a heat gun, apply heat to area indicated until the "Tab" bends to touch the other side of the pipe forming a ramp for tennis balls to freely exit the pipe.
5. Verify the configuration. The tab should form a smooth arc-ramp such that a tennis ball can fall the length of the pipe and be ejected out the cutout to roll a minimum of 12' on low-pile carpet.
6. The precise trajectory of the balls is not specified.

Drawn by:
Brazos BEST

scale = 0

Title:

Catalyst Dispenser

Dwg. No.

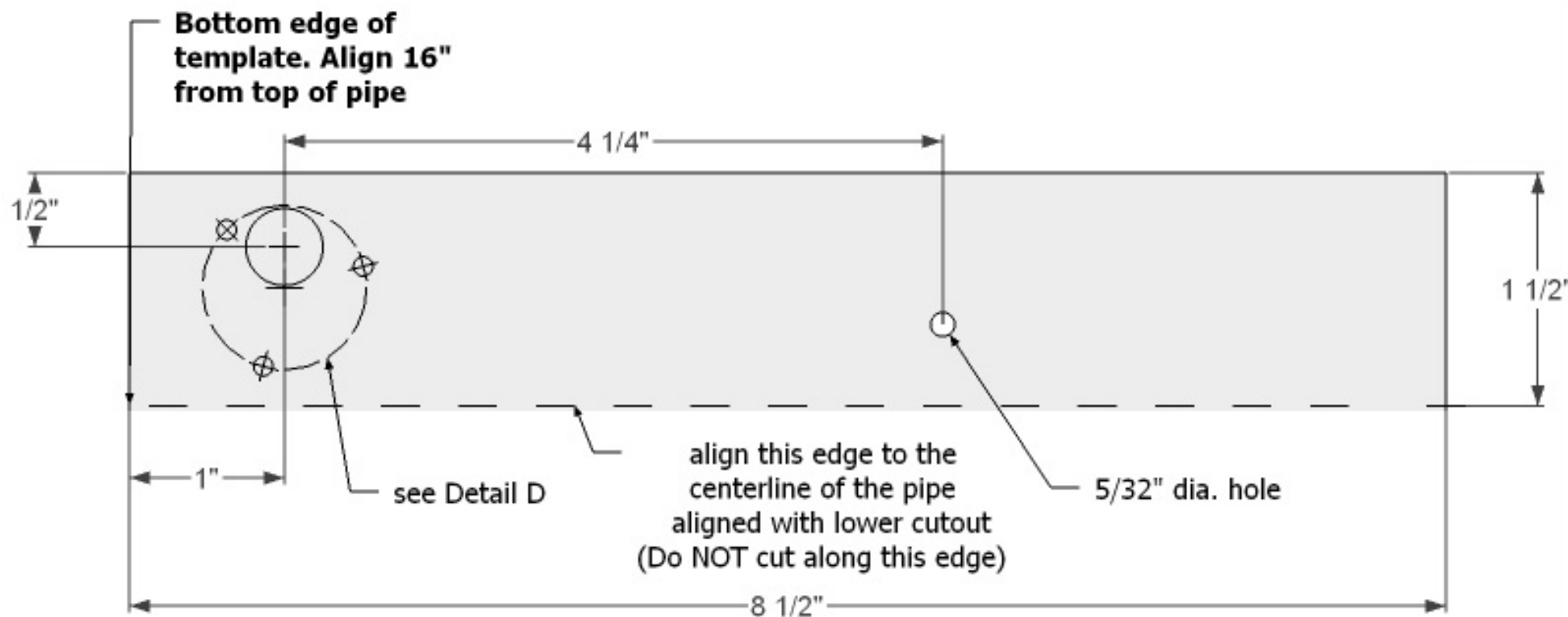
2009PC-10

Rev

2.0

BEST Robotics Inc.

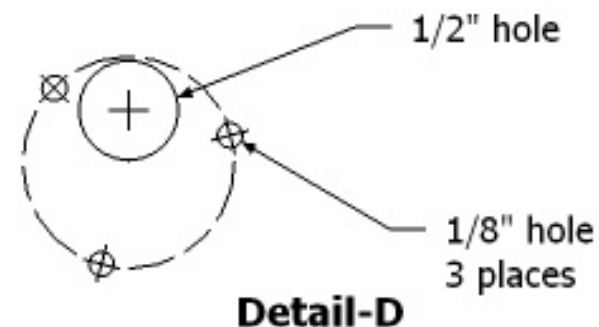
sheet 2 of 4



Instructions:

1. Print this page to scale.
2. Position bottom edge 16" from top edge of PVC pipe with dashed line along longitudinal centerline of pipe and aligned with center of the lower cutout on the pipe.
3. Temporarily affix to pipe.
4. Drill 1/8" dia. , 1/2" dia. , and 5/32" dia. holes.
5. Use a jig saw to cut along three solid edges only. Any corners may be rounded to 1/4" radius.
6. Use a heat gun to apply heat in region of the dashed line and bend until this cutout piece is perpendicular to the pipe surface as shown in Detail C (sheet 4).
7. Apply heat again and clamp the cutout piece between two flat pieces of wood making the bend formed at the dashed line as straight and sharp as possible. This process should also remove curvature from the flap.

Template B



Title:

Catalyst Dispenser

Dwg. No.

2009PC-10

Rev

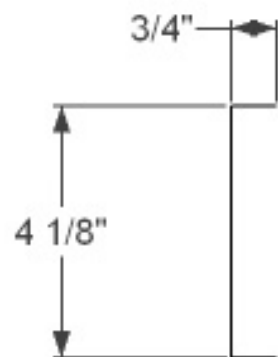
2.0

Drawn by:
Brazos BEST

scale = 0

BEST Robotics Inc.

sheet 3 of 4



**Detail of final
linking rod shape
(step 4)**

Instructions:

1. Install #8x1" long machine screw through mounting tab and secure with #8 nut on farside of PVC tab.
2. Carefully thread Cam (PN 2009PC-12) onto machine screw through center hole. If hole becomes stripped, then a second nut should be installed with loctite, positioned such that Cam is free to spin on the screw.
3. Install Motor Hub (PN 2009PC-11) on motor shaft using setscrew supplied with the hub. Position the hub on the shaft such that the hub screws do not hit the motor mounting screws.
4. Create linking rod from 7" length of wire from marking flags or clothes hanger. Bend 3/4" of each end to 90 degrees.
5. Insert lower end of linking rod into predrilled hole in the motor hub. Then spin Cam to insert upper end of rod into a predrilled Cam hole.
6. Manually spin the motor hub to test the cam. If balls get bound between the Cam and pipe wall, then experiment with other Cam linking rod hole positions until the delivery is consistent.
7. If linking rod tends to work loose during operation, then add an additional bend to the last 1/8" of one end to keep it in place. Adding an additional bend to both ends will hinder service.

Cam
(step 2)

Motor Hub
(step 3)

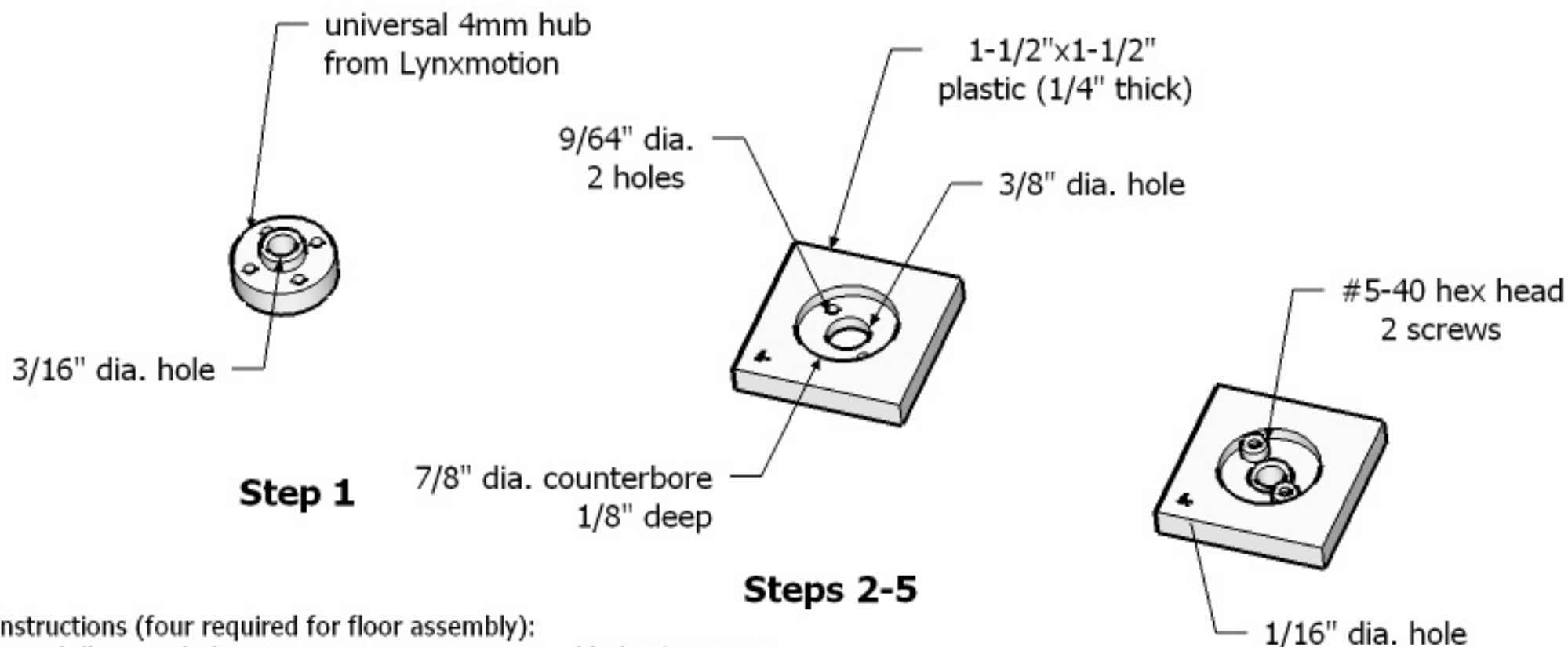
#8 screw and nut
(step 1)

Detail C

Drawn by:
Brazos BEST

scale = 0

Title: Catalyst Dispenser		
Dwg. No. 2009PC-10		Rev 2.0
BEST Robotics Inc.		sheet 4 of 4



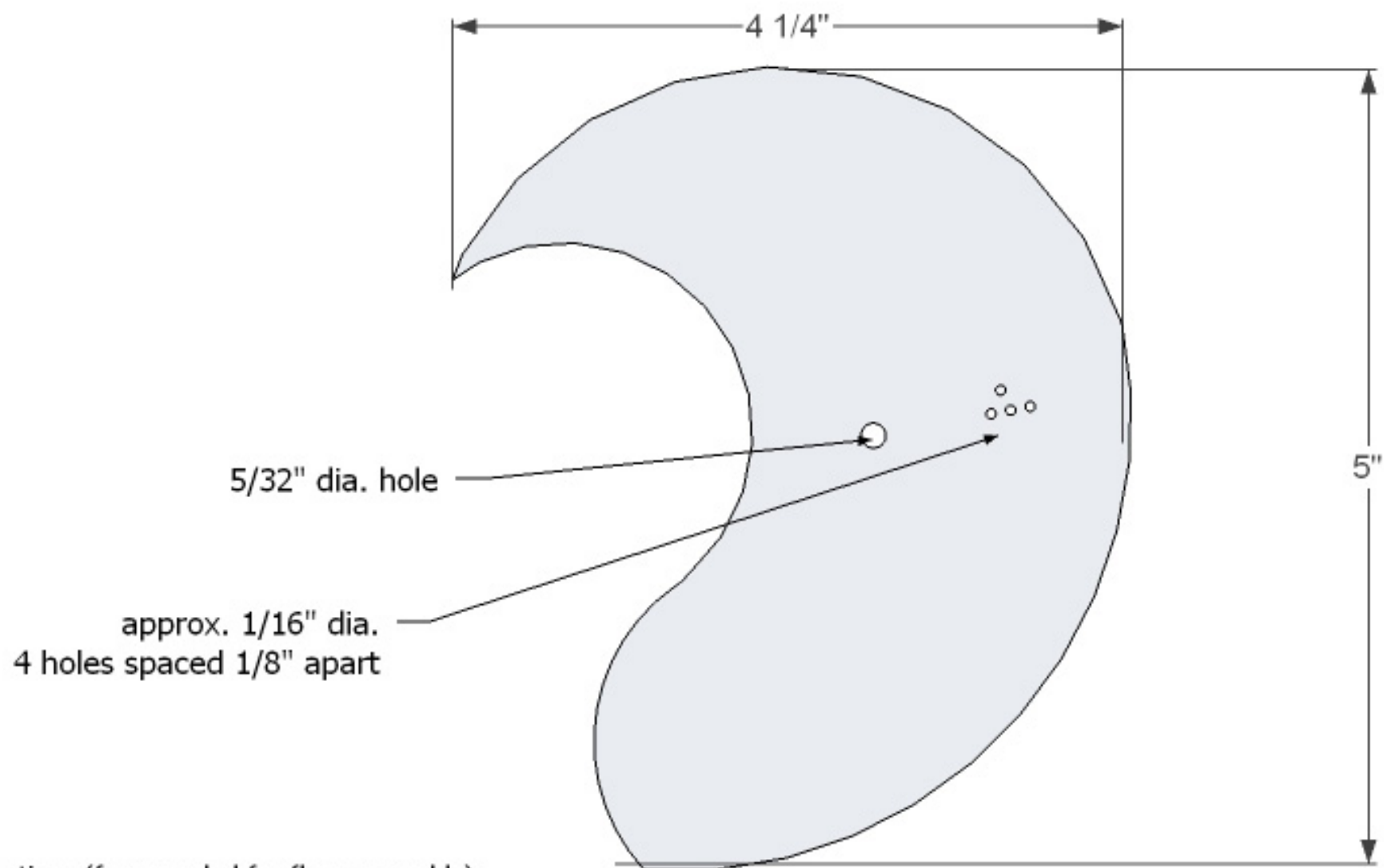
Instructions (four required for floor assembly):

1. Redrill center hole in Lynxmotion 4mm universal hub P/N HUB-03.
CAUTION must be taken not to damage the existing setscrew threads. Use a drillpress, secure workpiece, and proceed slowly. If threads are damaged during drilling operation, then the hole must be retapped.
2. Mark a 1-1/2" square on 1/4" plastic sheet, but do not cut it out yet. First drill holes and counterbore, then cut the square.
3. Counterbore in center of square plastic with 7/8" Forsner bit 1/8" deep.
4. Drill 3/8" hole through the center of the counterbore.
5. Cut out the 1-1/2" square piece from the 1/4" plastic sheet.
6. Align plastic atop the hub and mark two hole locations for mounting the plastic piece to the hub mounting holes. Drill the two 9/64" dia. holes in the plastic.
7. Install plastic atop the hub using two #5-40 hex head screws that come with the hub.
8. Choose small drill bit (approximately 1/16" dia.) to match dia. of rigid wire that will drive the cam (use either thick metal clothes hanger or wire staff from marking flags). Drill hole through plastic approximately 1/4" from corner as shown.

Drawn by:
Brazos BEST

scale = 0

Title: Small Motor Hub		
Dwg. No. 2009PC-11		Rev 1.0
BEST Robotics Inc.		sheet 1 of 1



Instructions (four needed for floor assembly):

1. Print multiple copies of this page to scale or print one copy of "Quick Template".
2. Temporarily affix the printout to 1/4" plastic sheet using spray adhesive.
3. Using a drill press, drill 5/32" hole for cam axle and a series of smaller holes (approx. 1/16" dia. to provide a tight fit for the wire used on the dispenser linking rod). Nearest hole should be approx. 3/4" from cam axle hole.
4. Cut out part using a jig saw.
5. Remove all burs using sharp edge or a tool. All edges must be smooth to avoid getting caught on tennis ball fuzz. (Fine burs may be removed by exposing the part to a direct flame and smoothing the edges before it cools)

Drawn by:
Brazos BEST

scale = 0

Title:

Dispenser Cam

Dwg. No.

2009PC-12

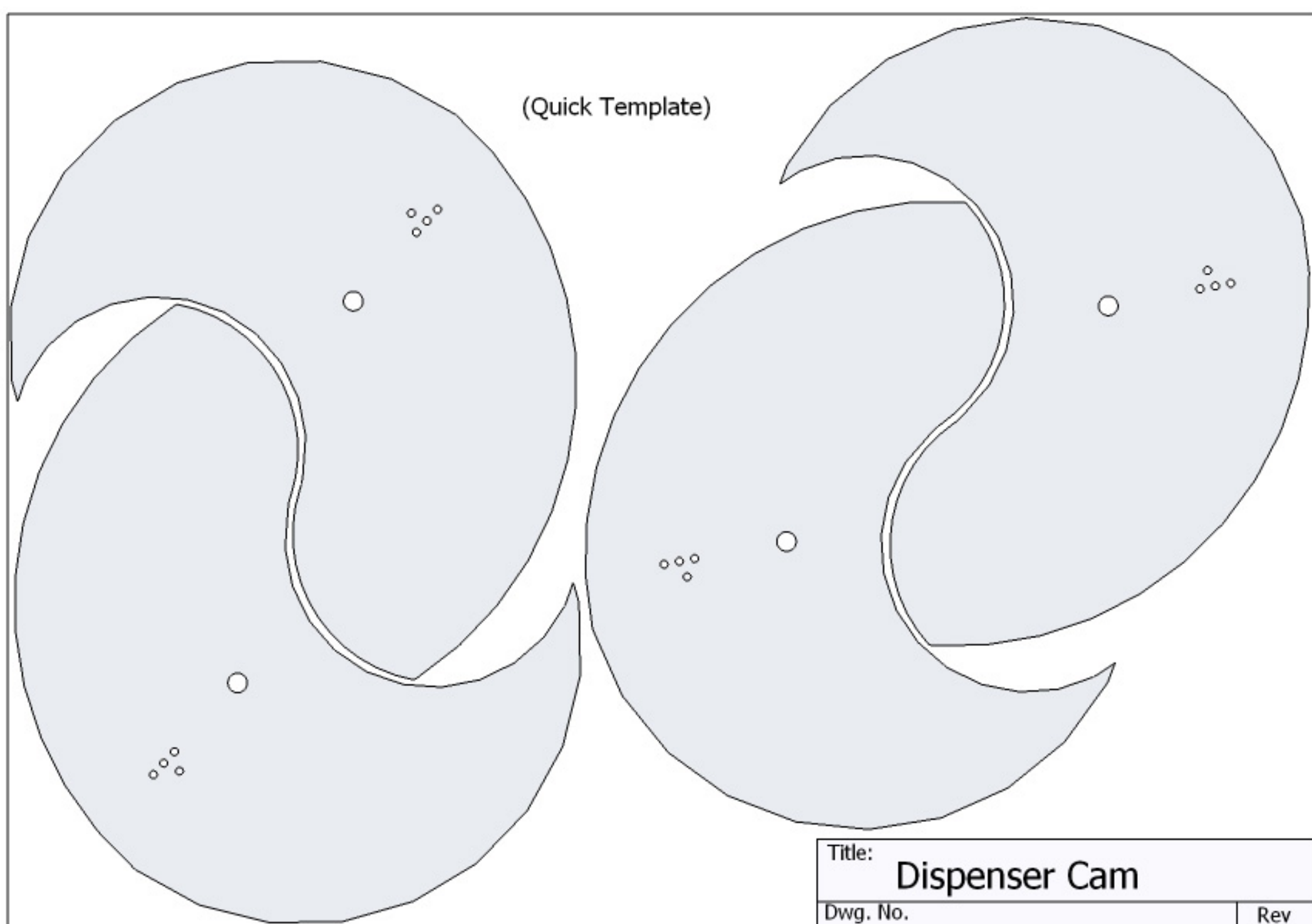
Rev

1.0

BEST Robotics Inc.

sheet 1 of 2

(Quick Template)



Title:

Dispenser Cam

Dwg. No.

2009PC-12

Rev

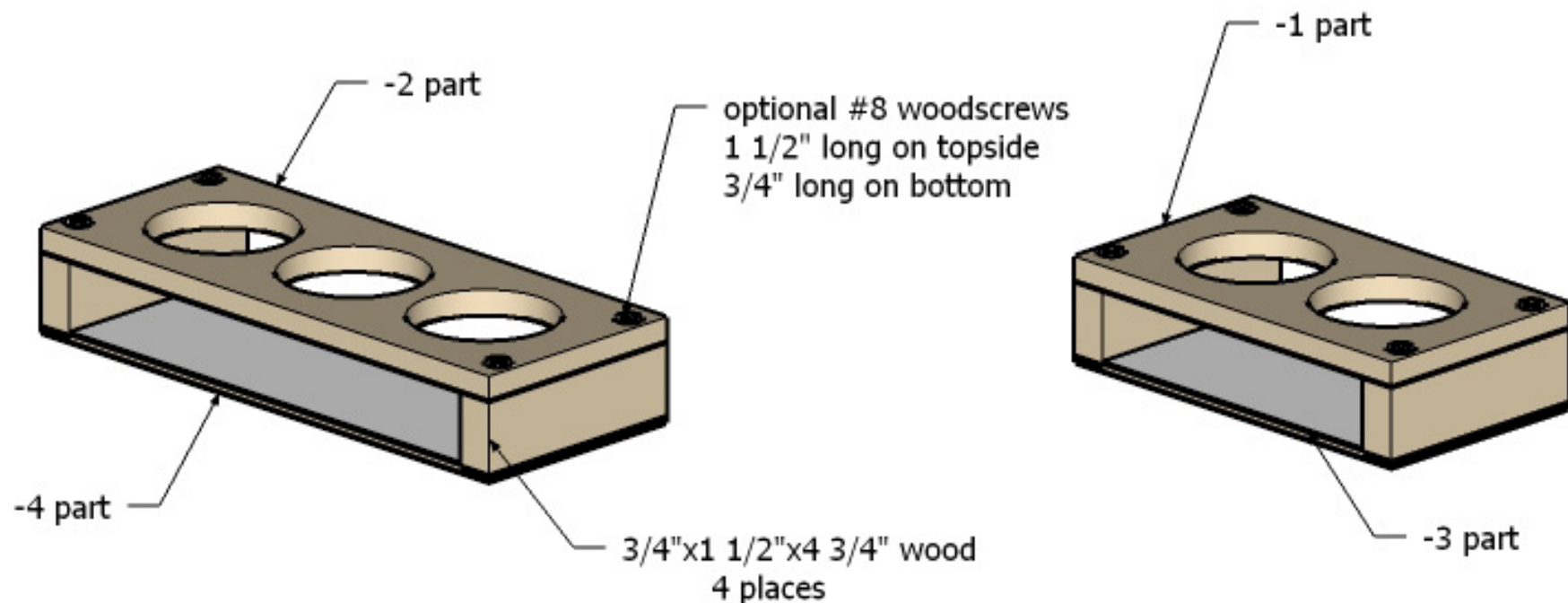
1.0

Drawn by:
Brazos BEST

scale = 0

BEST Robotics Inc.

sheet 2 of 2



Instructions (four of each are required for final floor assembly):

1. Create four blocks of wood measuring 3/4"x1 1/2"x4 3/4".
2. Position -1, -2, -3, -4 parts on the blocks of wood as shown.
Make sure that the corners of abutting pieces align.
3. Affix pieces using either glue and brad nails OR #8 woodscrews.
If screws are used, 1 1/2" long screws should be used on top side and 3/4" long screws should be used on bottom side. All screws should be preceded with pilot holes and clearance holes to close gaps and prevent splitting.

Drawn by:
Brazos BEST

scale = 0

Title:

Energy Receptacle

Dwg. No.

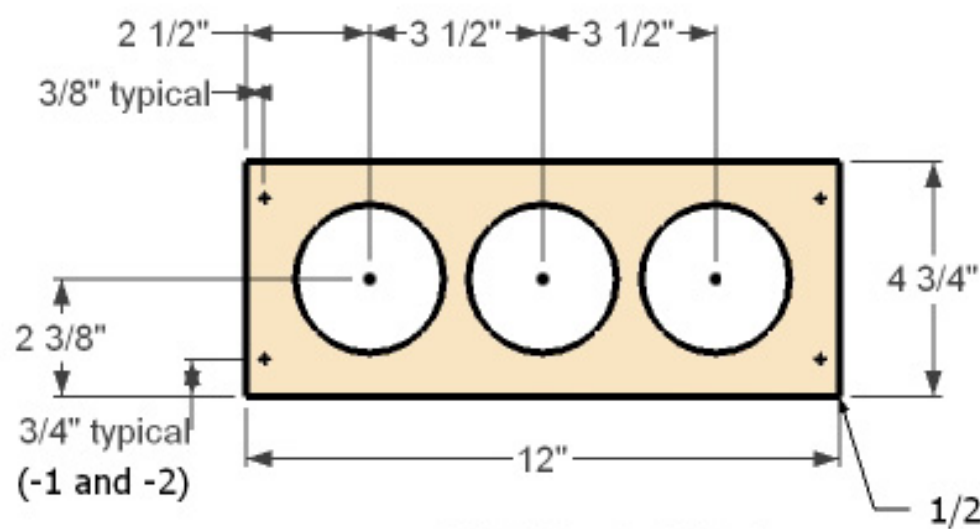
2009PC-20

Rev

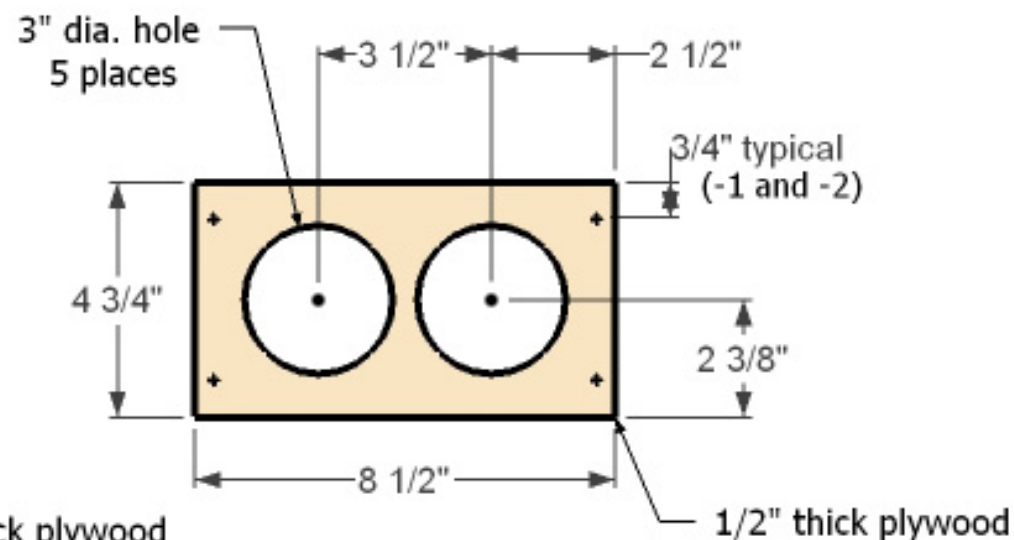
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BEST Robotics Inc.

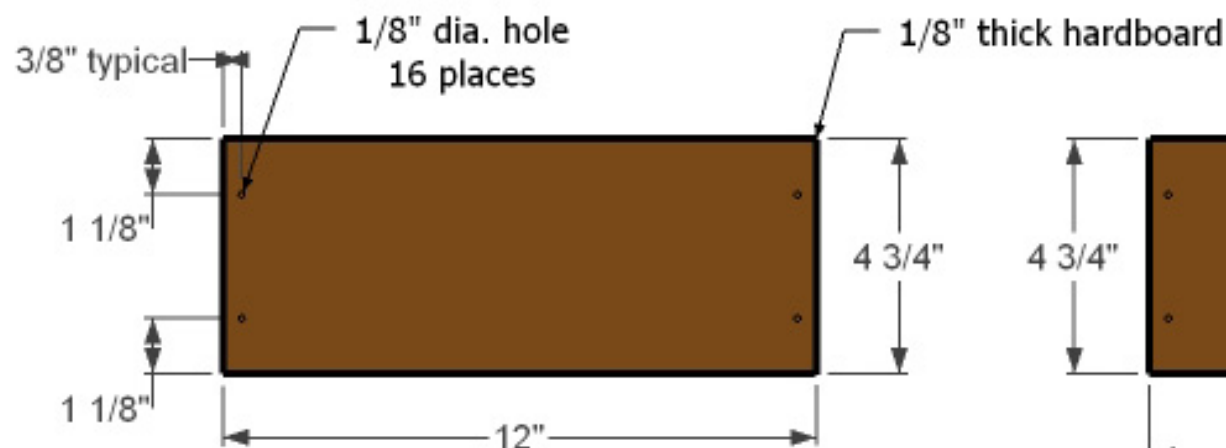
sheet 1 of 2



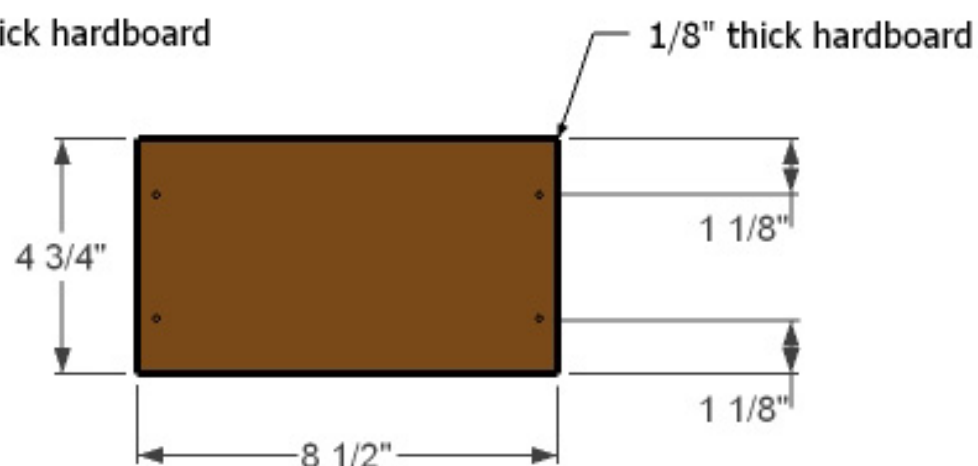
2009PC-20-2



2009PC-20-1



2009PC-20-4



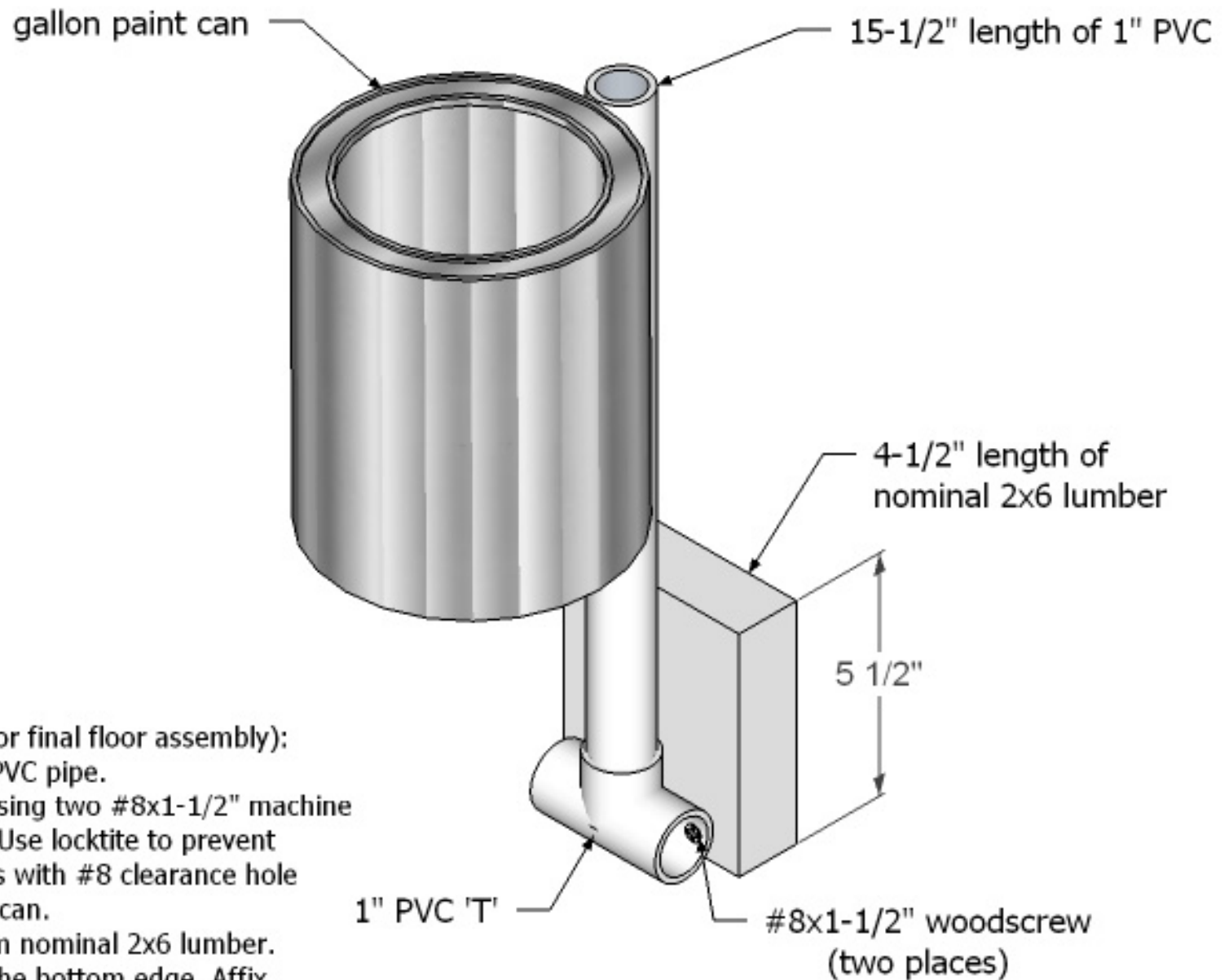
2009PC-20-3

Instructions (four of each are required for final floor assembly):

1. Cut 3" dia. holes as shown.
2. Only drill 1/8" dia. holes if screws will be used to assemble the part.
1/8" dia. holes on the -1 and -3 are located to prevent interference from the top screws and bottom screws upon final assembly. Similarly, the holes on the -2 and -4 are staggered.

Title: Energy Receptacle		
Dwg. No. 2009PC-20		Rev 1.0
scale = 0	BEST Robotics Inc.	sheet 2 of 2

Drawn by:
Brazos BEST



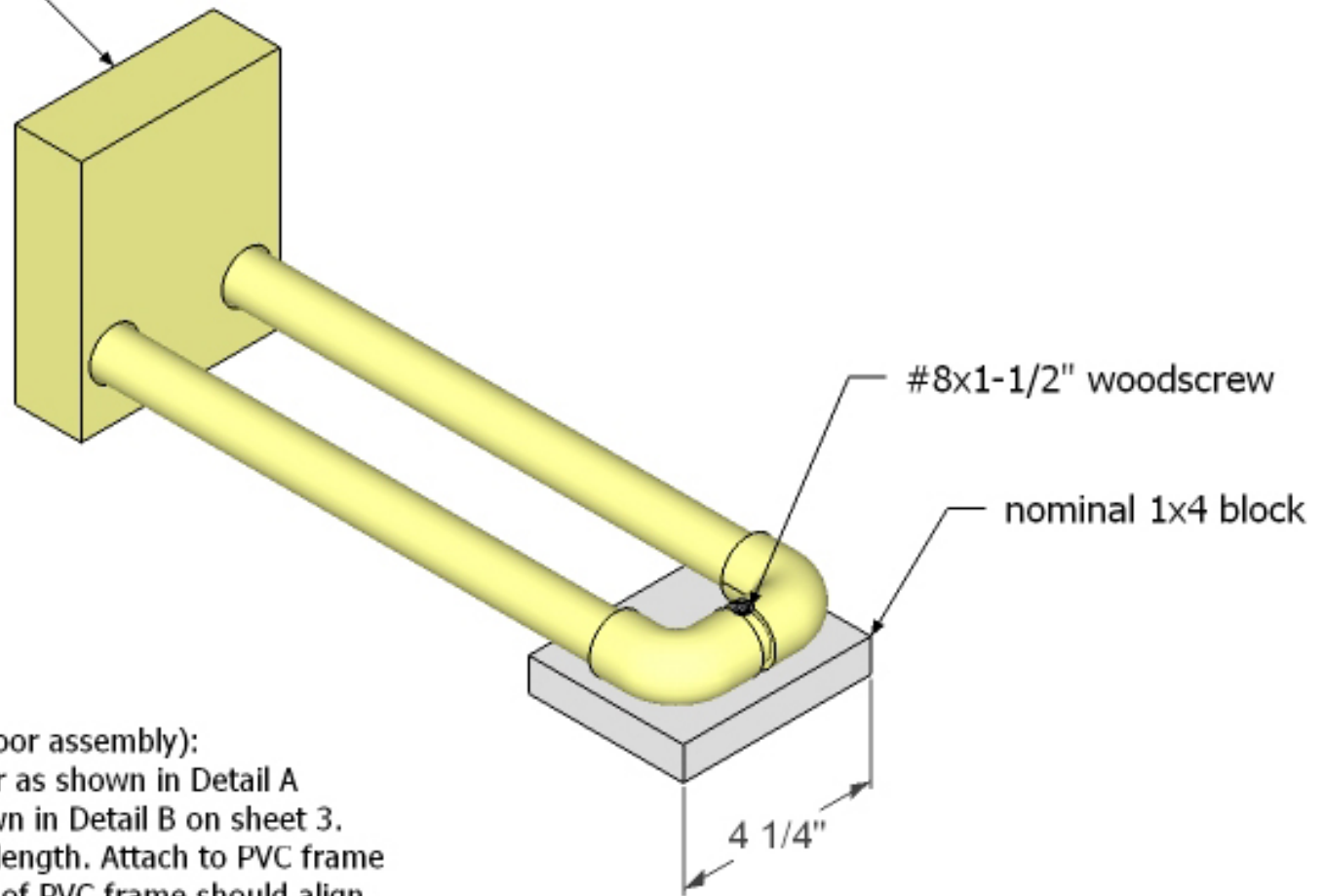
Instructions (four required for final floor assembly):

1. Cut 15-1/2" length of 1" PVC pipe.
2. Affix to gallon paint can using two #8x1-1/2" machine screws and two #8 nuts. Use locktite to prevent loosening. Preceed screws with #8 clearance hole through the pipe and the can.
3. Cut 4-1/2" long block from nominal 2x6 lumber.
4. Center a 1" PVC T along the bottom edge. Affix with two #8x1-1/2" woodscrews. Preceed screws with clearance hole in the pipe and a pilot hole in the wood as necessary to prevent splitting. Screws can be angled towards the middle from the outside edge of the T.
5. Press pipe into the T. Do NOT use PVC Cement. Pipe can be removed for compact storage of the game floor.

Title: Tall CO2 Receptacle		
Dwg. No. 2009PC-30		Rev 1.0
scale = 0	BEST Robotics Inc.	sheet 1 of 1

Drawn by:
Brazos BEST

See Detail A
on sheet 2



Instructions (four required for final floor assembly):

1. Cut block from nominal 2x6 lumber as shown in Detail A
2. Build PVC frame from 3/4" as shown in Detail B on sheet 3.
3. Cut nominal 1x4 lumber to 4-1/4" length. Attach to PVC frame using #8x1-1/2" wood screw. End of PVC frame should align with edge of block.
4. Insert PVC frame fully into holes in block.
5. Drill 1/8" dia. holes in bottom of block as indicated in Detail A. Fully penetrate the PVC pipes.
6. Install two #8x1-1/2" woodscrews to secure the PVC frame to the block.

Title:

Catalyst Receptacle

Dwg. No.

2009PC-40

Rev

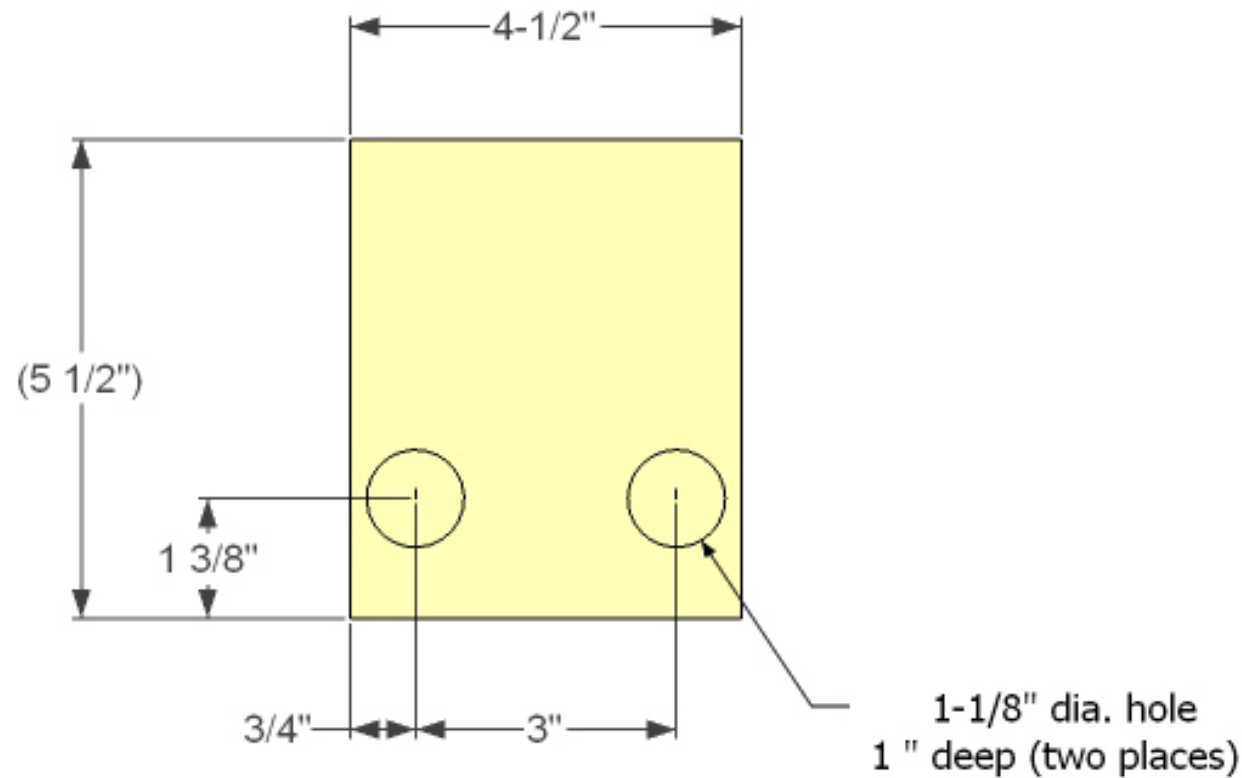
2.1

Drawn by:
Brazos BEST

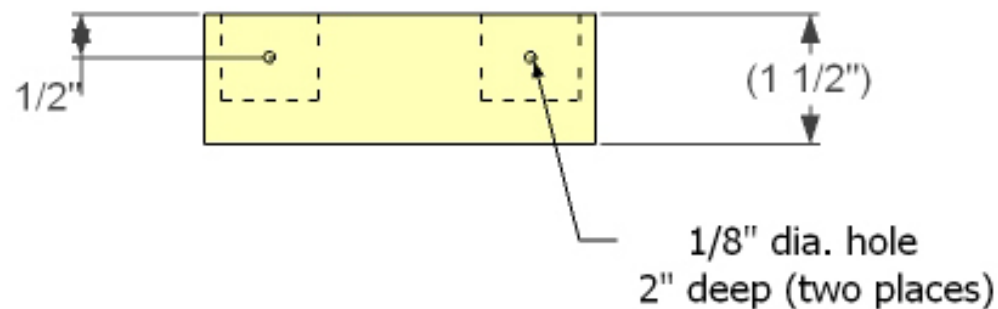
scale = 0

BEST Robotics Inc.

sheet 1 of 3



Detail A



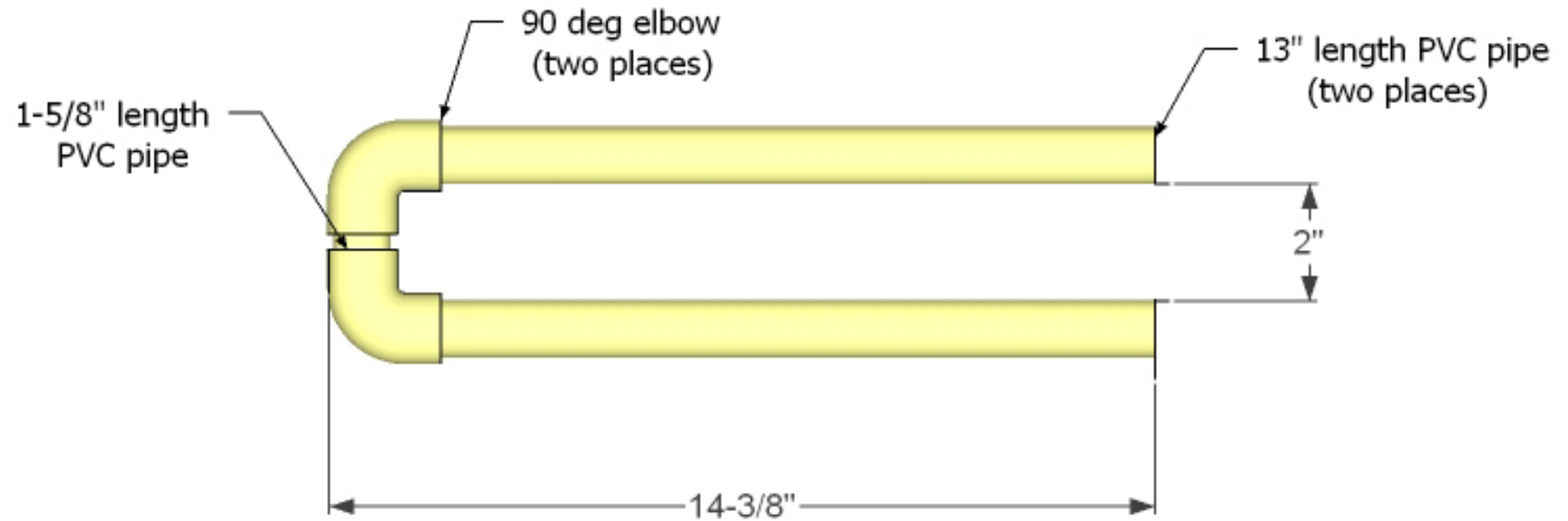
Instructions (four required for final floor assembly):

1. Cut 4-1/2" length of nominal 2x6 lumber.
2. Drill two 1-1/8" dia. holes 1" deep as shown using spade bit or forsnor bit.
3. Drill two 1/8" dia. holes through bottom of board, completely penetrating the holes drilled in step 2.

Drawn by:
Brazos BEST

scale = 0

Title: Catalyst Receptacle		
Dwg. No. 2009PC-40		Rev 2.1
BEST Robotics Inc.		sheet 2 of 3

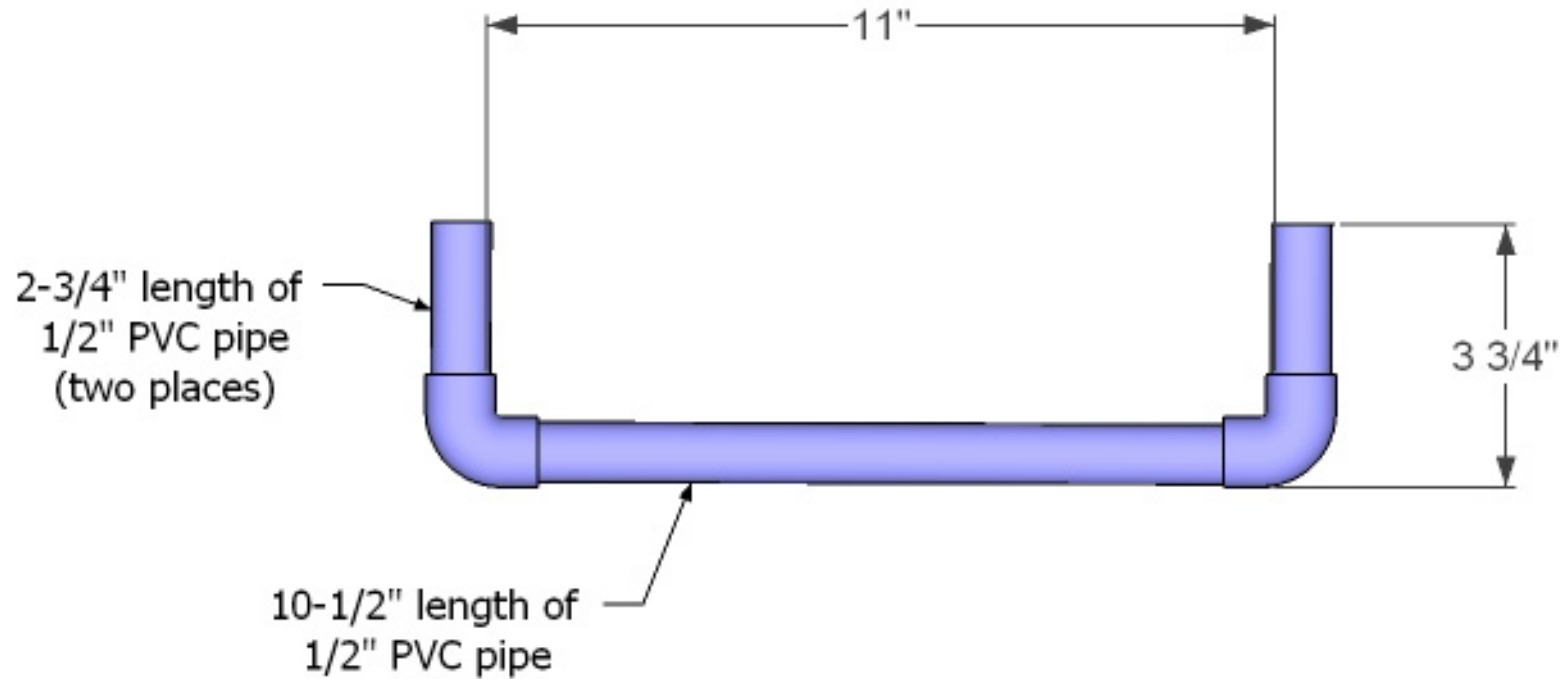


Detail B

Instructions (four required for final floor assembly):

1. Cut lengths of 3/4" PVC pipe as indicated.
2. Tap firmly into elbows to produce dimensioned shape.
PVC cement is not required.

Title: Catalyst Receptacle		
Dwg. No. 2009PC-40		Rev 2.1
Drawn by: Brazos BEST		
scale = 0	BEST Robotics Inc.	sheet 3 of 3



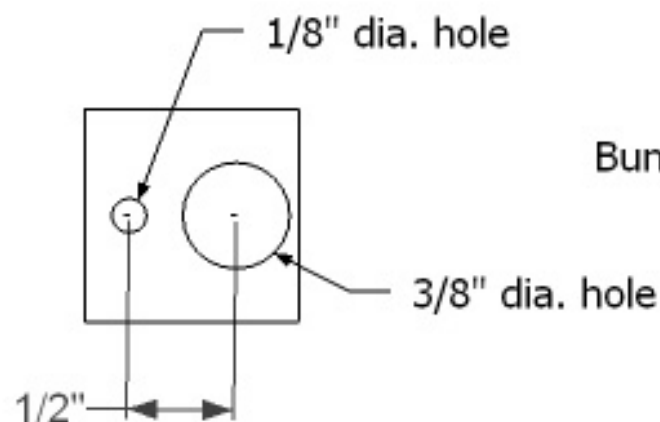
Instructions (four required for final floor assembly):

1. Cut lengths of 1/2" nominal dia. PVC pipe as indicated.
2. Tap pieces firmly into 90 deg elbows to form shape.
PVC cement is not required.

Drawn by:
Brazos BEST

scale = 0

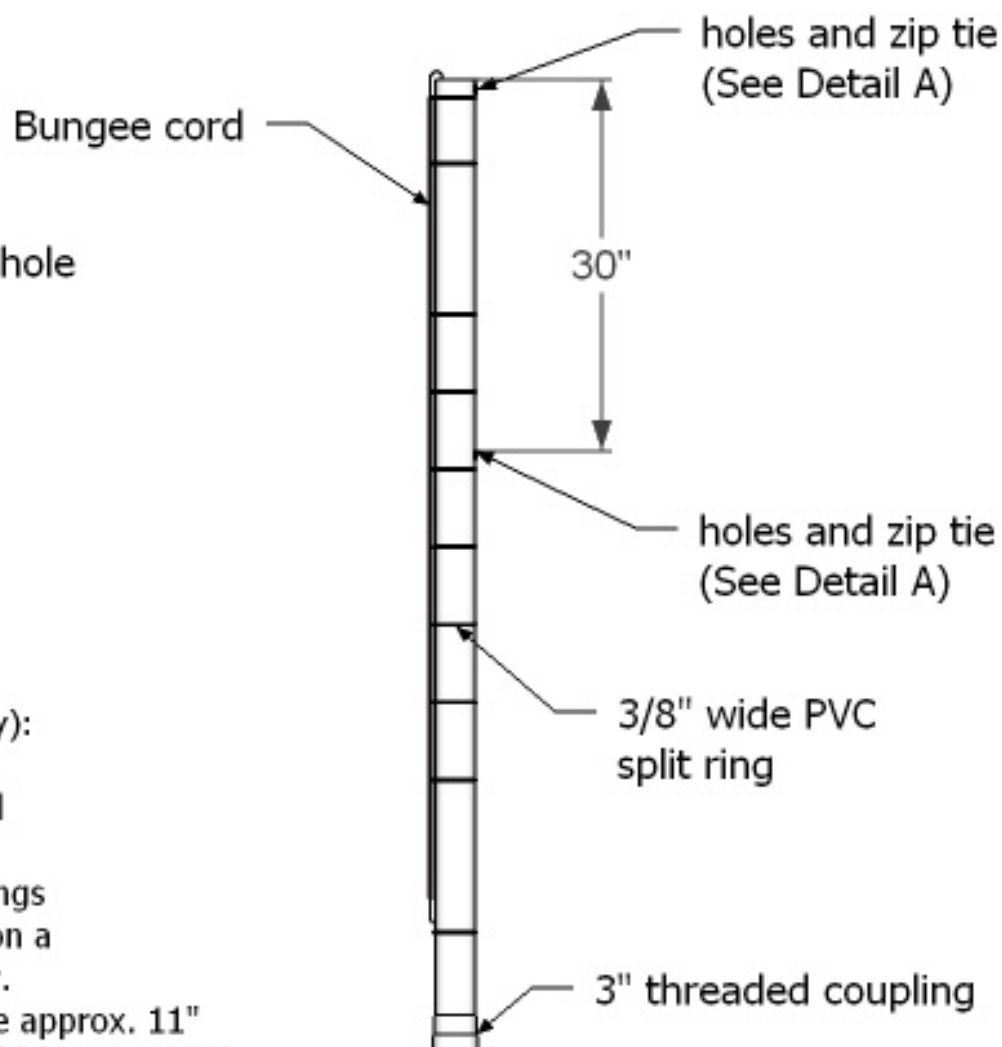
Title: H2O Receptacle		
Dwg. No. 2009PC-50		Rev 1.0
BEST Robotics Inc.	sheet 1 of 1	



Detail A

Instructions (four required for final floor assembly):

1. Begin with 80" length of 3" D2729 sewer pipe.
2. Install 3" threaded PVC coupling to bottom end of pipe using PVC cement.
3. (optional) Install seven to ten 3/8" wide PVC rings at 6"-10" intervals as desired to mimic seems on a refinery smokestack. Tape in place if necessary.
4. Drill one 3/8" dia. hole through one wall of pipe approx. 11" from bottom of assembly. Install 36" (freelength) bungee cord by inserting one hook into the hole and the other hook over the top edge of the pipe.
5. Drill the hole pattern shown in Detail A on side of pipe opposite the Bungee cord approx. 1" from top of pipe. Insert 4" nylon tie strap through the two holes and form a 1/2" dia. loop with the tie strap.
6. Repeat step 5 at a location approx. 30" below the first hole pattern.



Title:

Stratosphere Support Leg

Dwg. No.

2009PC-60

Rev

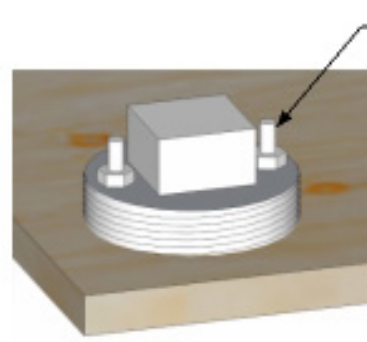
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Drawn by:
Brazos BEST

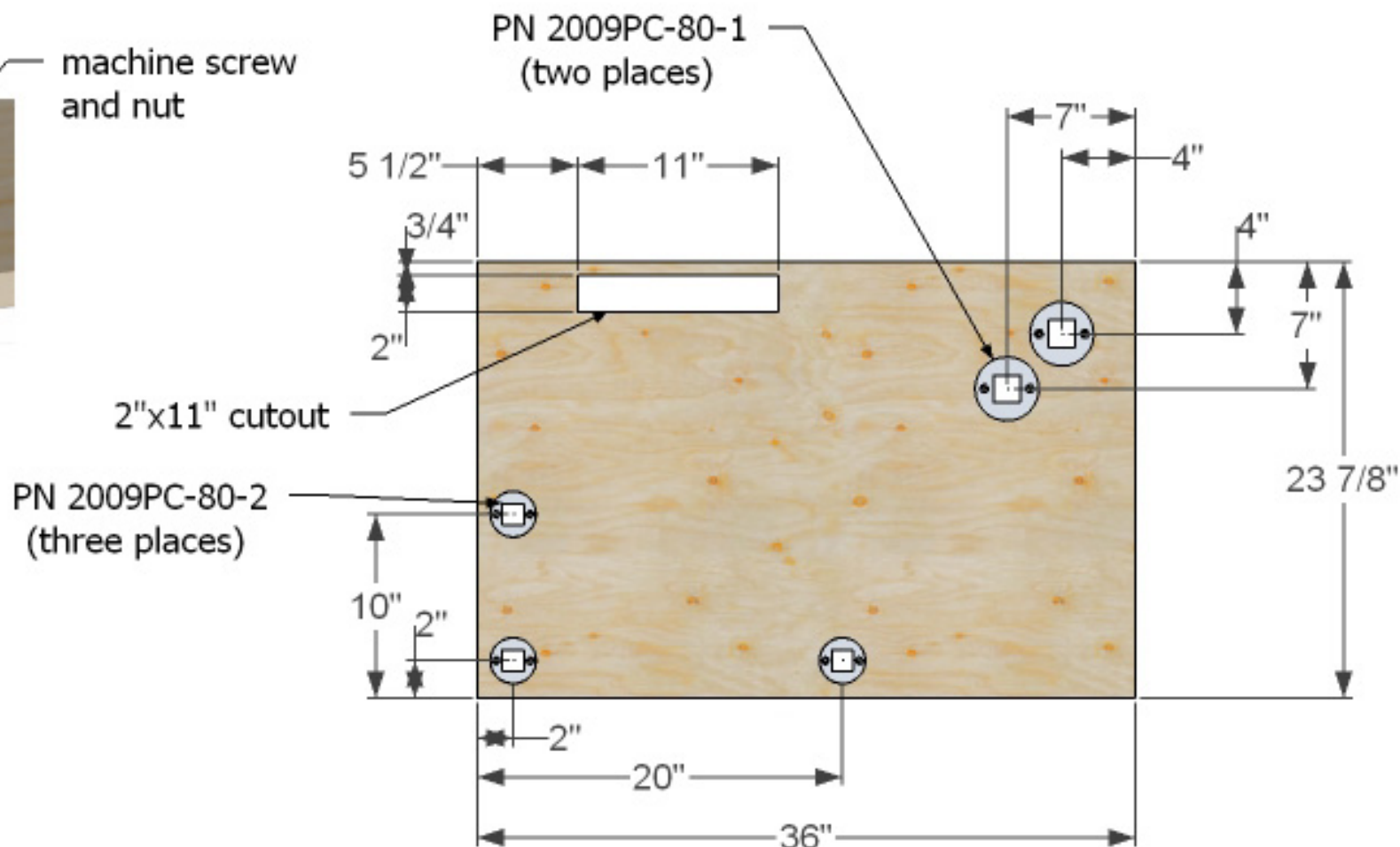
scale = 0

BEST Robotics Inc.

sheet 1 of 1



Detail A



Instructions (four required for final floor assembly):

1. Begin with 1/2" thick plywood cut to size.
2. Create 2"x11" cutout located as shown.
3. Modify 2" and 3" PVC pipe plugs as shown in drawing 2009PC-80.
4. Locate each modified pipe plug as shown and affix as follows:
 - Drill 1/16" dia. pilot hole through the plywood to match the holes in the plug.
 - Drill 1/2" dia. counterbore by 1/8" deep on bottom side of plywood.
 - Drill 1/4" dia. hole through the center of the counterbore
 - (for 2" plug) Install two #10x1-1/2" machine screws and two #10 nuts to secure plug as shown in Detail A.
 - (for 3" plug) Install two #1/4x1-1/2" machine screws and two 1/4" nuts to secure plug as shown in Detail A.

Drawn by:
Brazos BEST

scale = 0

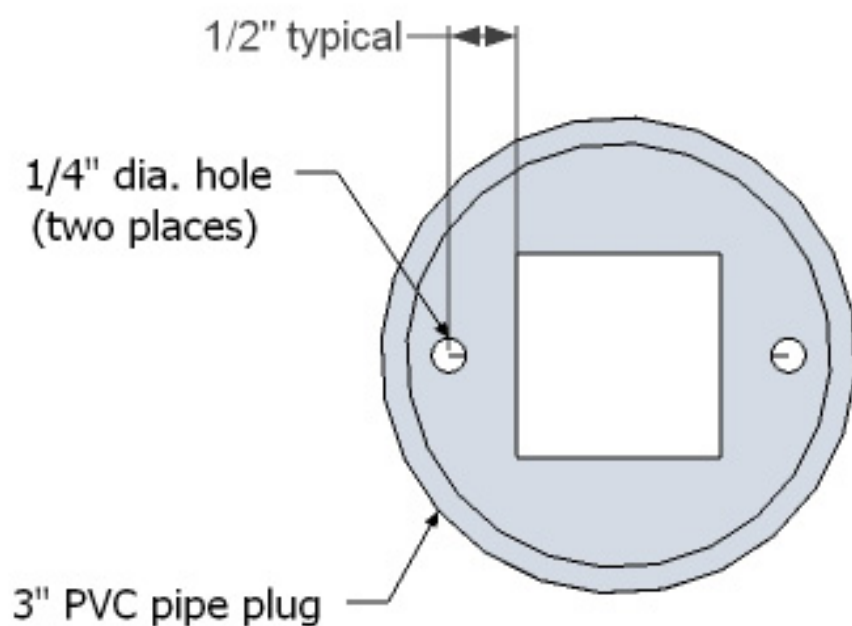
Title:
Processing Cell Base

Dwg. No.
2009PC-70

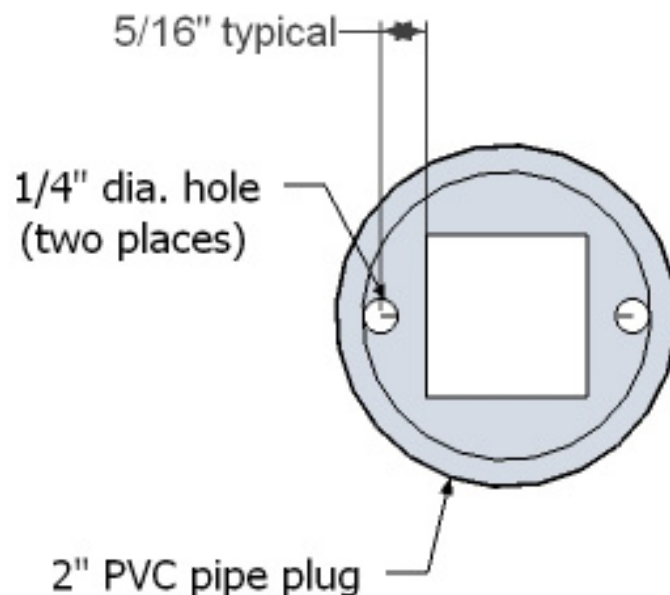
Rev
1.0

BEST Robotics Inc.

sheet 1 of 1



-1 Detail: Viewed from bottom
(eight required for final floor assembly)

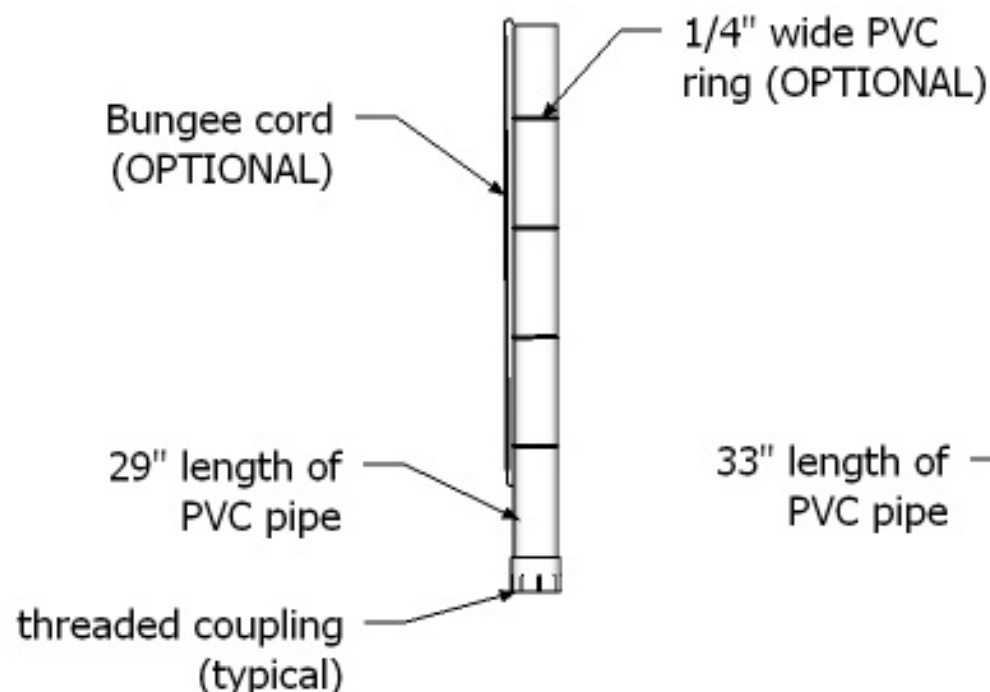


-2 Detail: Viewed from bottom
(twelve required for final floor assembly)

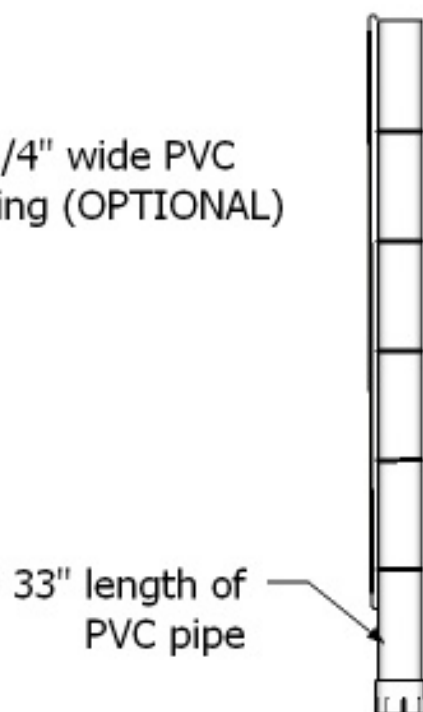
Instructions:

1. Begin with PVC pipe plug. Drill 1/4" dia. holes as shown.
Holes should be as close to the outer wall as possible without actually penetrating outer wall.

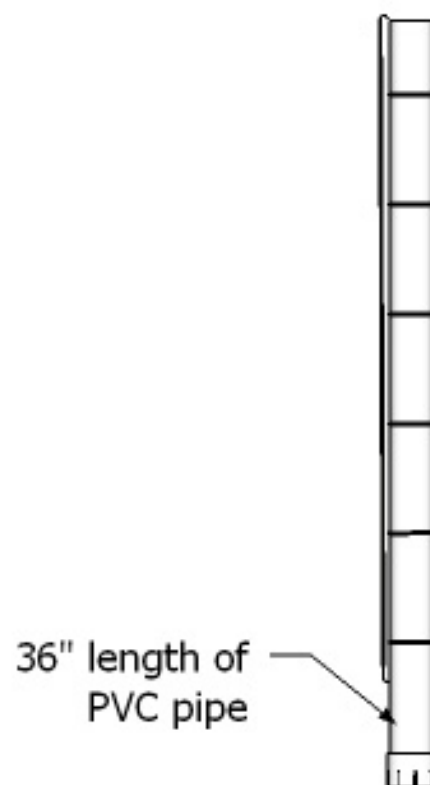
Title: PVC Pipe Plug Mod		
Dwg. No. 2009PC-80		Rev 1.0
Drawn by: Brazos BEST	BEST Robotics Inc.	
scale = 0	sheet 1 of 1	



2009PC-90-1
(four required for
final floor assembly)



2009PC-90-2
(four required for
final floor assembly)



2009PC-90-3
(four required for
final floor assembly)

Instructions (Wear safety goggles if cutting PVC with power tools):

All three towers should be cut from a single 10' piece of pipe. Scrap is used later.

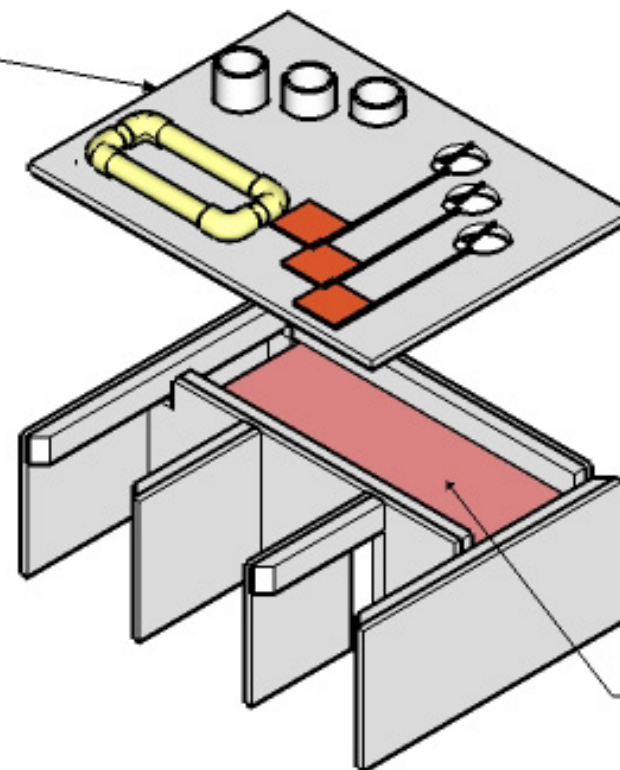
1. Begin with length of 2" PVC pipe as shown.
2. Install threaded coupling on one end and secure with PVC cement. Ensure that cement does not damage threads.
3. Cut 1/4" wide PVC rings from scrap 2" pipe. Snip each ring with wire cutters to form split ring that can be spread apart and snapped onto the tower.
4. Install a ring every 6-10" along each tower. Secure with white electrical tape if necessary.
5. Drill one 3/8" dia. hole sufficiently far from the top of pipe to slightly stretch available Bungee cord (approx. 20" frelength). Install Bungee cord by inserting one hook into the hole and the other hook over the top edge of the pipe.

Drawn by:
Brazos BEST

scale = 0

Title: Auxillary Cell Tower		
Dwg. No. 2009PC-90		Rev 2.0
BEST Robotics Inc.		sheet 1 of 1

Step 1
Storage Roof Assembly
(PN 2009S-40)



Step 2
8"x18" piece of 3/8"
plywood

Instructions (four required in final game floor assembly):
3/4" long fasteners with a slight countersink should be used.
In all cases, fasteners should be installed through the plywood
and into the 1x2 lumber. If screws are used, a minimum of two
should be used for each joint and each should be preceded with
clearance holes and pilot holes as necessary to close gaps and
prevent splitting. Glue and brad nails are an acceptable alternative
to screws as long as the gap is closed until the glue dries.

1. Install Storage Roof Assembly onto assembly. Ensure that
multiple fasteners penetrate each of the Partitions, Sides,
and Rear braces.
2. Install 8"x18" piece of 3/8" plywood on underside of 1x2
braces that are on the Rear panels.

Title:

Storage Assembly

Dwg. No.

2009S-00

Rev

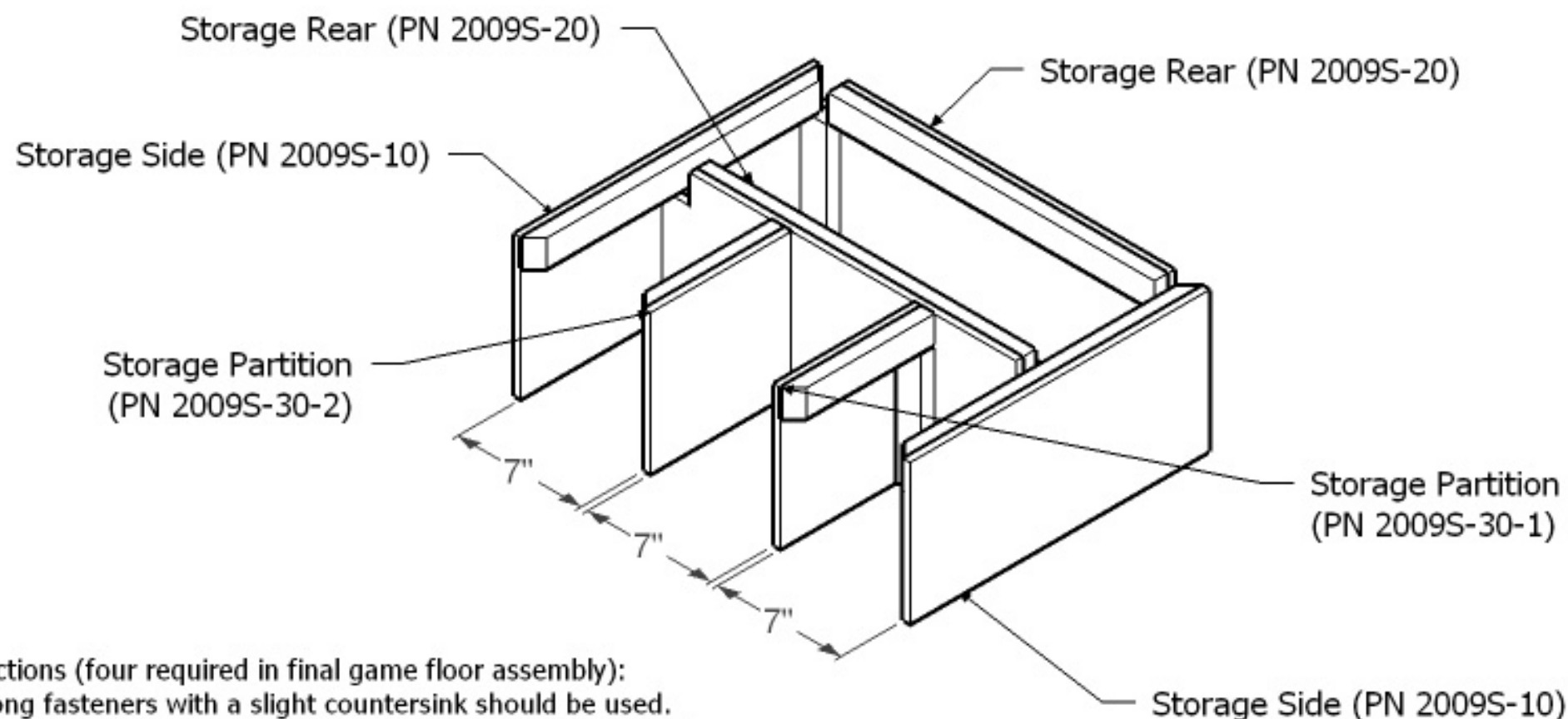
1.0

Drawn by:
Brazos BEST

scale = 0

BEST Robotics Inc.

sheet 1 of 2



Instructions (four required in final game floor assembly):
 3/4" long fasteners with a slight countersink should be used.
 In all cases, fasteners should be installed through the plywood
 and into the 1x2 lumber. If screws are used, a minimum of two
 should be used for each joint and each should be preceded with
 clearance holes and pilot holes as necessary to close gaps and
 prevent splitting. Glue and brad nails are an acceptable alternative
 to screws as long as the gap is closed until the glue dries.

1. Install Partition-1 and Partition -2 on first Rear panel. Position as dimensioned.
2. Install two Sides on the assembly as shown. Front edge of both sides and both partitions should form a plane. Alignment is easily achieved by standing the assembly on the front face.
3. Install second Rear panel on the assembly as shown. Back plane of the rear panel should align with back edges of side panels.

Drawn by:
 Brazos BEST

scale = 0

Title:

Storage Assembly

Dwg. No.

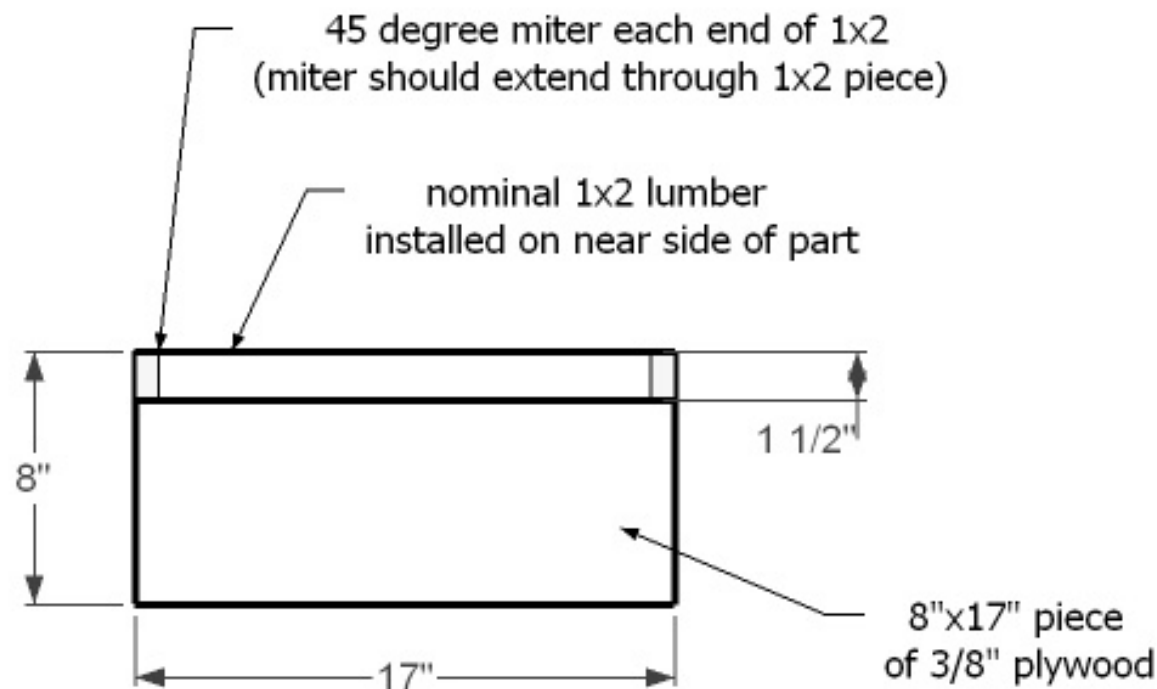
2009S-00

Rev

1.0

BEST Robotics Inc.

sheet 2 of 2



Instructions (eight required for final gamefloor assembly):

3/4" long fasteners with a slight countersink should be used.

In all cases, fasteners should be installed through the plywood and into the 1x2 lumber. If screws are used, a minimum of two should be used for each joint and each should be preceded with clearance holes and pilot holes as necessary to close gaps and prevent splitting. Glue and brad nails are an acceptable alternative to screws as long as the gap is closed until the glue dries.

1. Begin with 8"x17" piece of 3/8" plywood.

2. Miter both ends of a 17" piece of nominal 1x2 lumber and install as shown.

Title:

Storage: Side

Dwg. No.

2009S-10

Rev

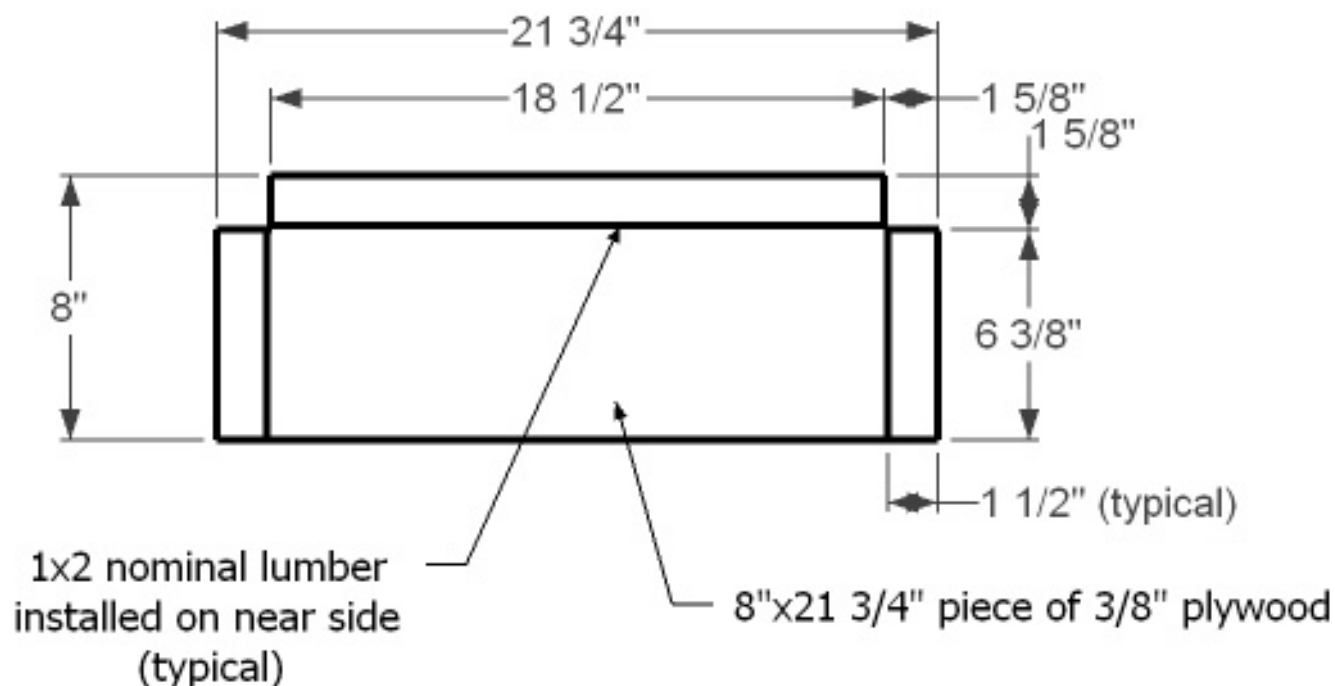
1.0

Drawn by:
Brazos BEST

scale = 0

BEST Robotics Inc.

sheet 1 of 1



Instructions (eight required in final game floor assembly):

$\frac{3}{4}"$ long fasteners with a slight countersink should be used.

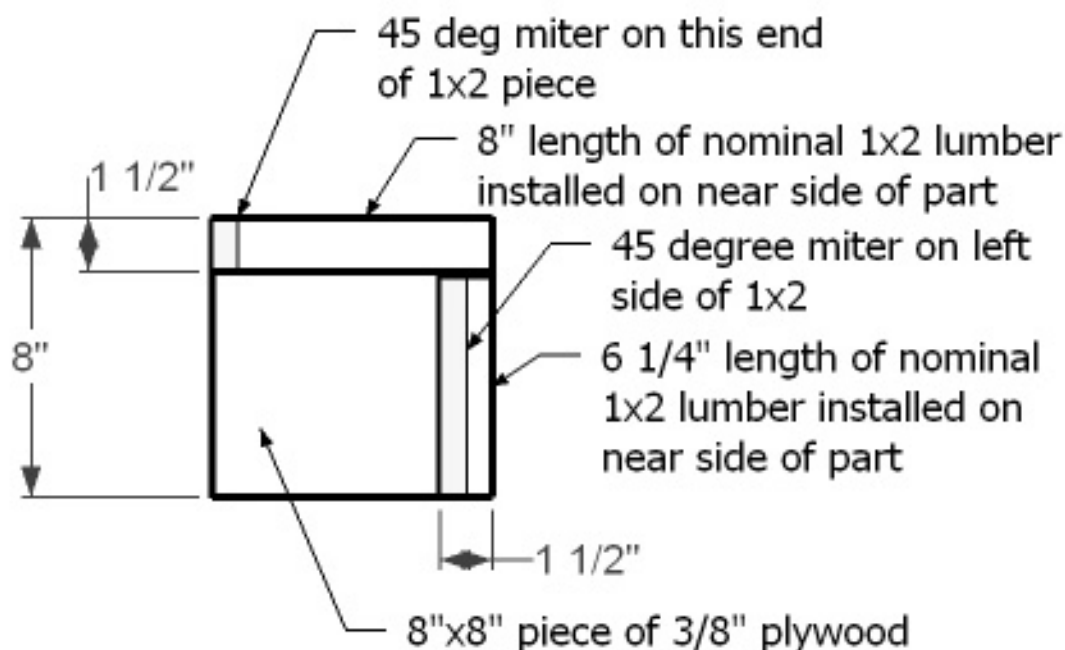
In all cases, fasteners should be installed through the plywood and into the 1×2 lumber. If screws are used, a minimum of two should be used for each joint and each should be preceded with clearance holes and pilot holes as necessary to close gaps and prevent splitting. Glue and brad nails are an acceptable alternative to screws as long as the gap is closed until the glue dries.

1. Cut $1 \frac{5}{8}"$ square notch in upper right corner and in upper left corner of $8" \times 21 \frac{3}{4}"$ piece of $\frac{3}{8}"$ plywood.
2. Install three pieces of nominal 1×2 lumber (lengths as shown) on near side of plywood.

Drawn by:
Brazos BEST

scale = 0

Title: Storage: Rear		
Dwg. No. 2009S-20		Rev 1.0
BEST Robotics Inc.		sheet 1 of 1



2009S-30-1

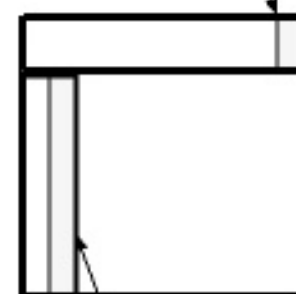
(four required in final game floor assembly)

Instructions:

3/4" long fasteners with a slight countersink should be used. In all cases, fasteners should be installed through the plywood and into the 1x2 lumber. If screws are used, a minimum of two should be used for each joint and each should be preceded with clearance holes and pilot holes as necessary to close gaps and prevent splitting. Glue and brad nails are an acceptable alternative to screws as long as the gap is closed until the glue dries.

1. Prepare the 6 1/4" lengths of nominal 1x2 lumber by ripping a 60" piece of lumber lengthwise with a table saw blade tilted to 45 degrees. (a total of 60" of nominal 1x2 will be sufficient to do all parts for the entire gamefloor). Miter should extend through entire piece.
2. Install 6 1/4" length from step 1 by aligning with two sides of 8"x8" square plywood.
3. Install 8" length of nominal 1x2 lumber with miter on one end at 45 degrees through thickness of part.

45 deg miter on this end of 1x2 piece



45 degree miter on right side of 1x2

2009S-30-2

(-2 is a mirror image of -1)

(four required in final game floor assembly)

Title:

Storage: Partition

Dwg. No.

2009S-30

Rev

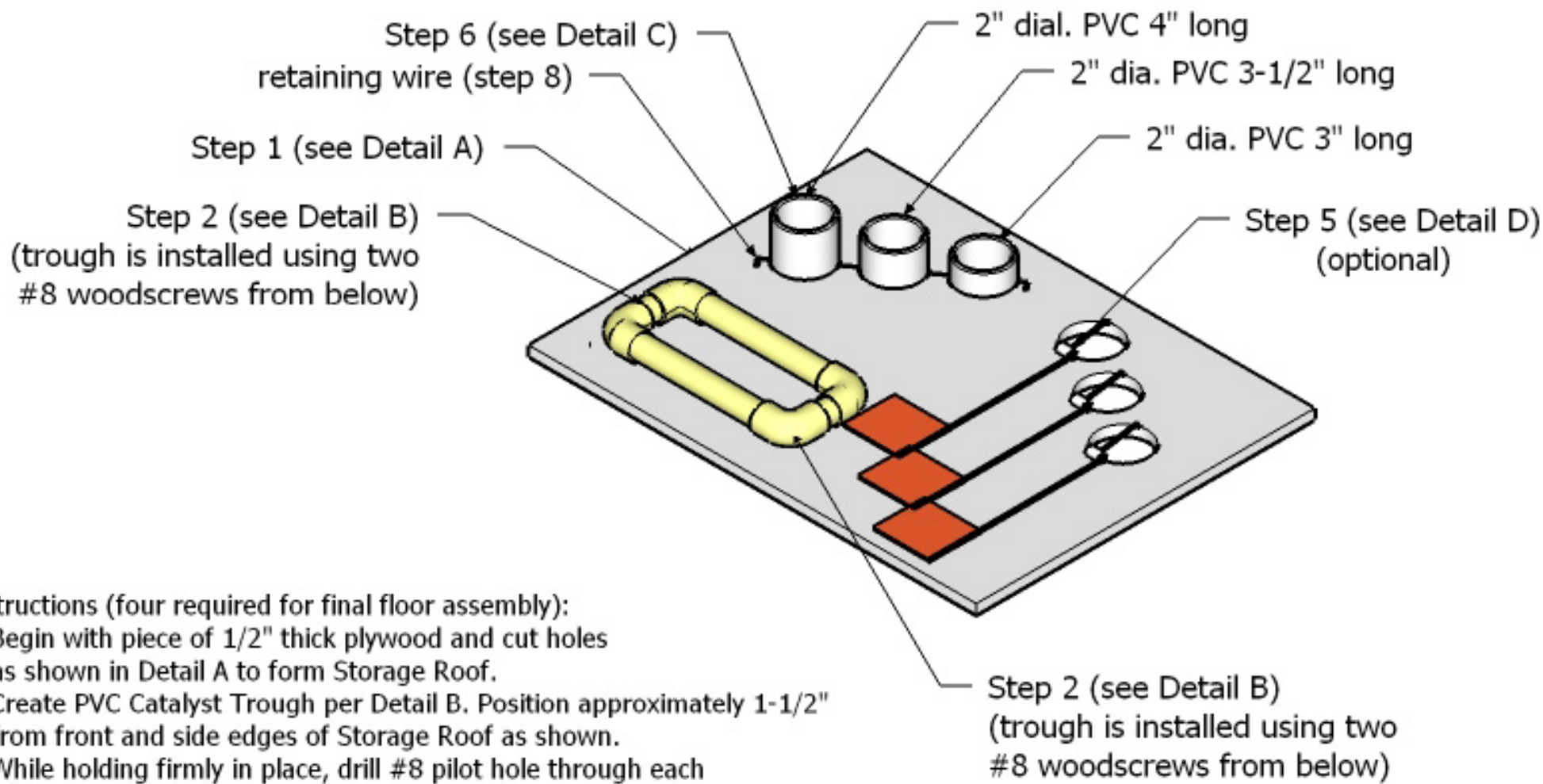
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Drawn by:
Brazos BEST

scale = 0

BEST Robotics Inc.

sheet 1 of 1



Instructions (four required for final floor assembly):

1. Begin with piece of 1/2" thick plywood and cut holes as shown in Detail A to form Storage Roof.
2. Create PVC Catalyst Trough per Detail B. Position approximately 1-1/2" from front and side edges of Storage Roof as shown.
3. While holding firmly in place, drill #8 pilot hole through each of the long PVC pieces, continuing through the Storage Roof.
4. Attach the Catalyst Trough using two #8x3/4 wood screws through the plywood and into the PVC.
5. (Optional) Install a signal flag on the edge of each of the three energy receptacle holes as shown in Detail D.
6. Cut and drill lengths of 2" dia. PVC per Detail C.
7. Position pipes in holes as shown and thread a single piece of rigid wire (11" long) through the lower pilot holes in all three pipes on the bottom side of the plywood. Bend wire around outer pipes to keep it in place.
8. Thread a single piece of rigid wire (11" long) through the upper pilot in all three pipes on the top side of the plywood. Bend wire around outer pipes to keep it in place.

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scale = 0

Title:

Storage: Roof Assembly

Dwg. No.

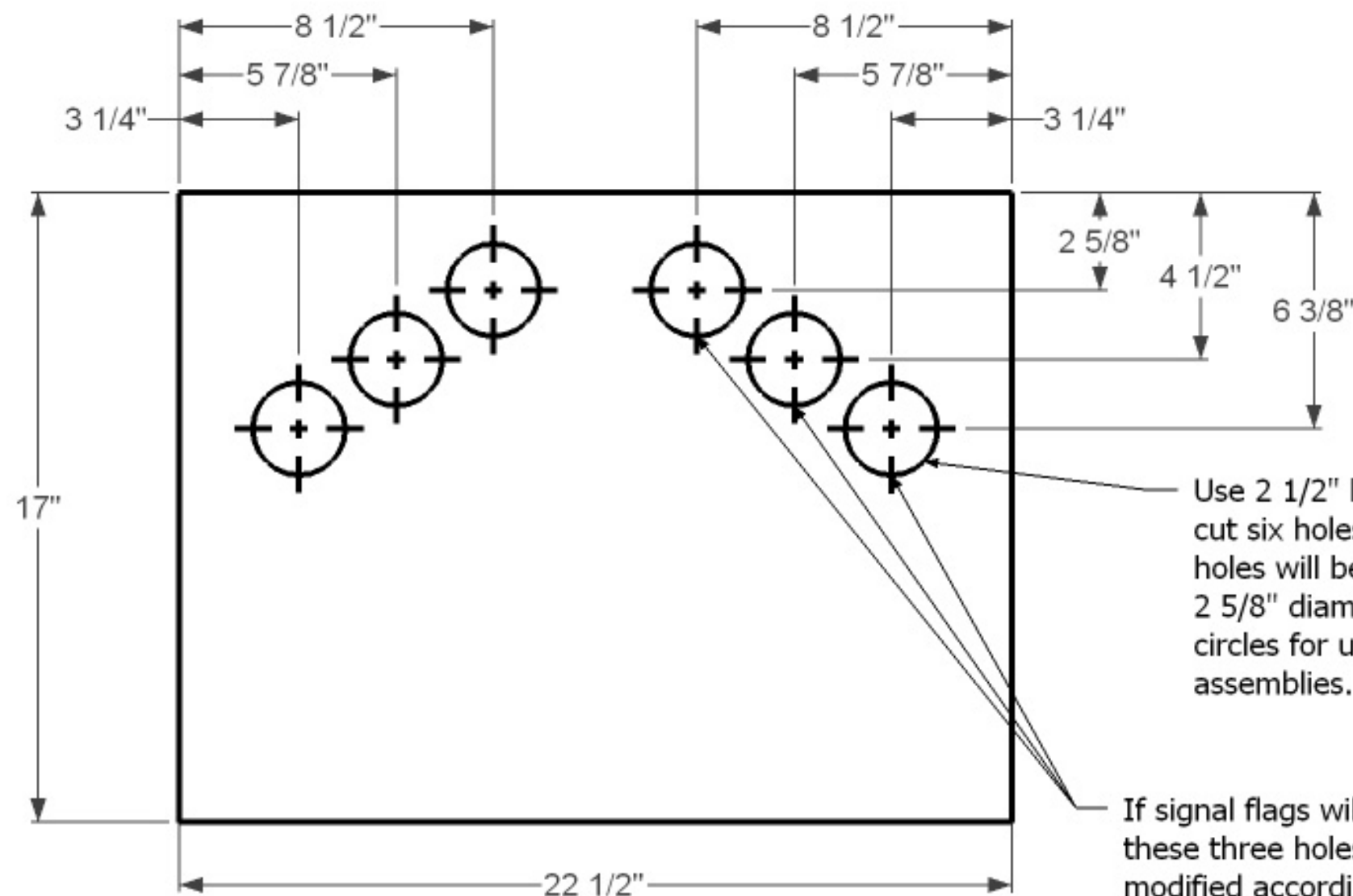
2009S-40

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sheet 1 of 4



Detail A
(Storage Roof)

Instructions (four required in final game floor assembly):

1. Part is made from 1/2" plywood
2. Use hole saw to cut holes. Save circles for use on Benzene Tanker assemblies.

Title:

Storage: Roof Assembly

Dwg. No.

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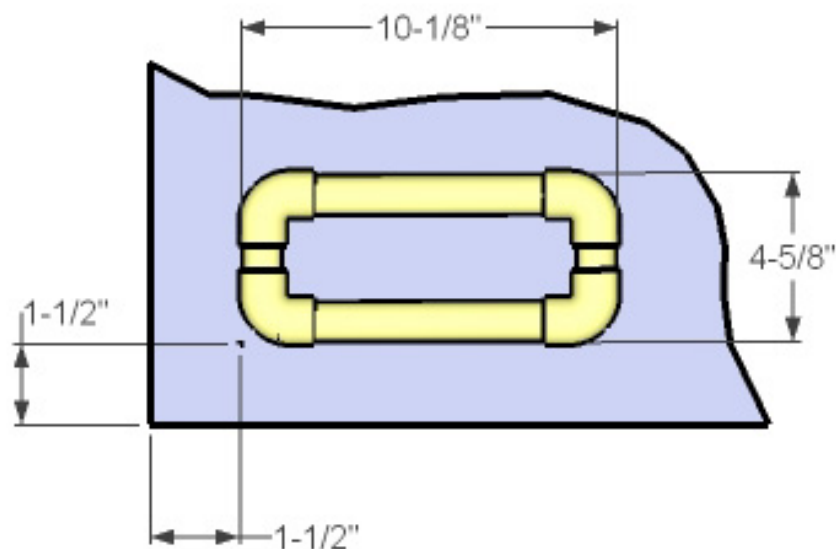
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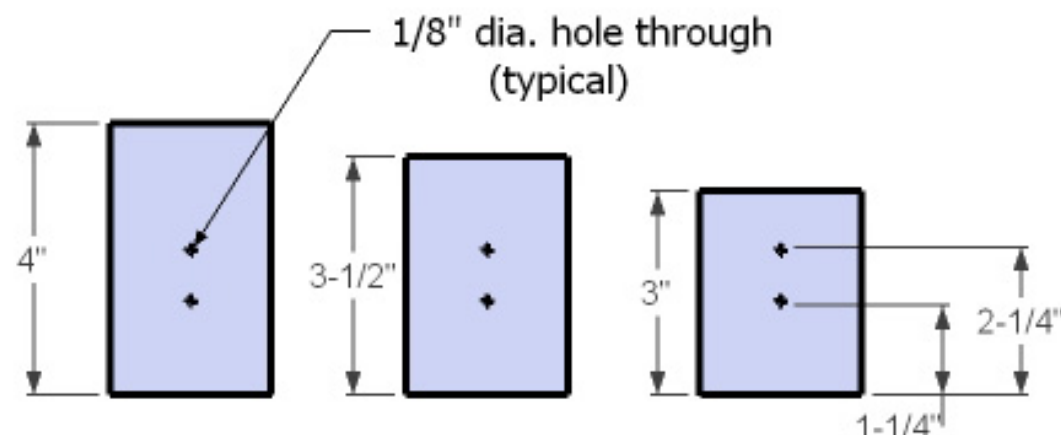
sheet 2 of 4



Detail B
Catalyst Trough

Instructions (four required for final floor assembly)

1. Using 3/4" sch 40 PVC pipe, cut two lengths of 2-1/4" and two lengths of 7-3/4".
2. Assemble using 90 deg. elbows as shown.
3. Tap together firmly. PVC Cement is NOT necessary.
4. Position on Storage Roof 1-1/2" from edges as shown on sheet 1.
5. Install with two #8x3/4 screws through the plywood and into the bottom of the long PVC pieces.



Detail C
H2O Stands

Instructions (four of each length required for final floor assembly):

1. Cut lengths from 2" dia. sch 40 PVC.
2. Drill 1/8" holes through both walls of pipe as shown.

Title:

Storage: Roof Assembly

Dwg. No.

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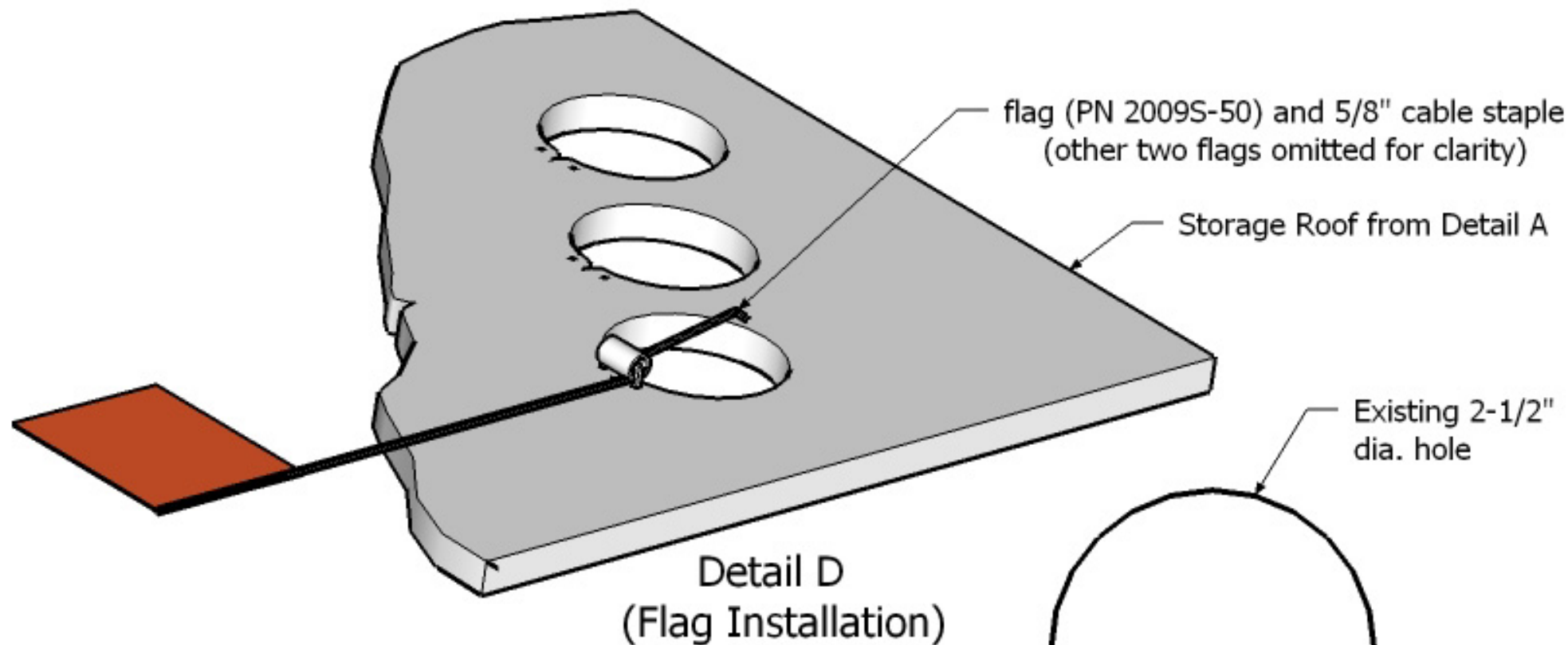
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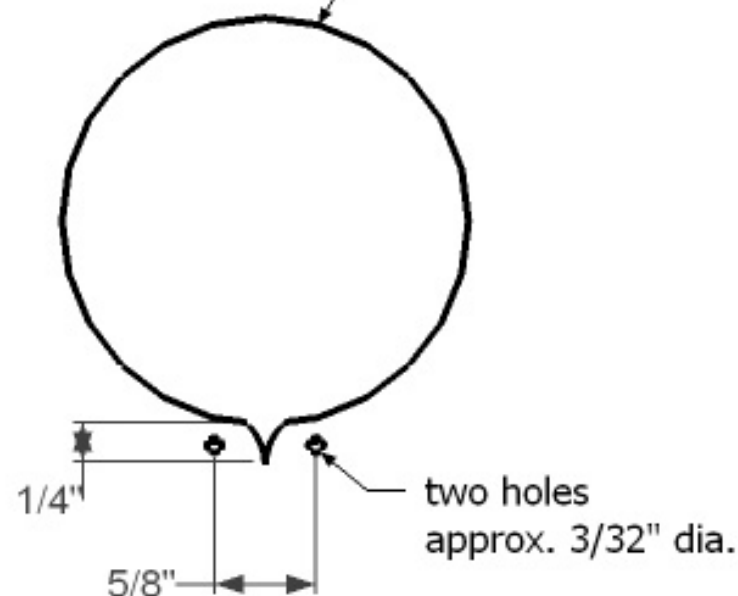
sheet 3 of 4



Instructions:

It is recommended that you test the installation, assembly, and operation of a single flag cutting all the holes or making all the flags. You may have to vary dimensions according to your material selection and build tendencies.

1. Cut a 1/4" wide by 1/4" long V-shaped notch on the side of each of the three energy receptacle holes using a jig saw.
2. Align a cable staple (approx. 5/8" wide) across the notch and tap sharply with a hammer to mark the location for pilot holes. Holes should leave at least 1/8" of material between the hole and any edges.
3. Drill two pilot holes with approx. 3/32" dia. (depending on your cable staples). The resulting fit should be tight but only require a small amount of tapping to install the staple.
4. Slip the cable staple through the coil with the flag (PN 2009S-50) lying flat against the plywood. Press and tap the staple until it is completely seated.
5. Test the operation with the actual energy cans to be used in the competition to ensure that there is no binding when either inserting or removing the can. If the flag coil binds on the staple, compress the coil with pliers or try one less turn when creating the coil.



Do this for three energy receptacle holes

Title:

Storage: Roof Assembly

Dwg. No.

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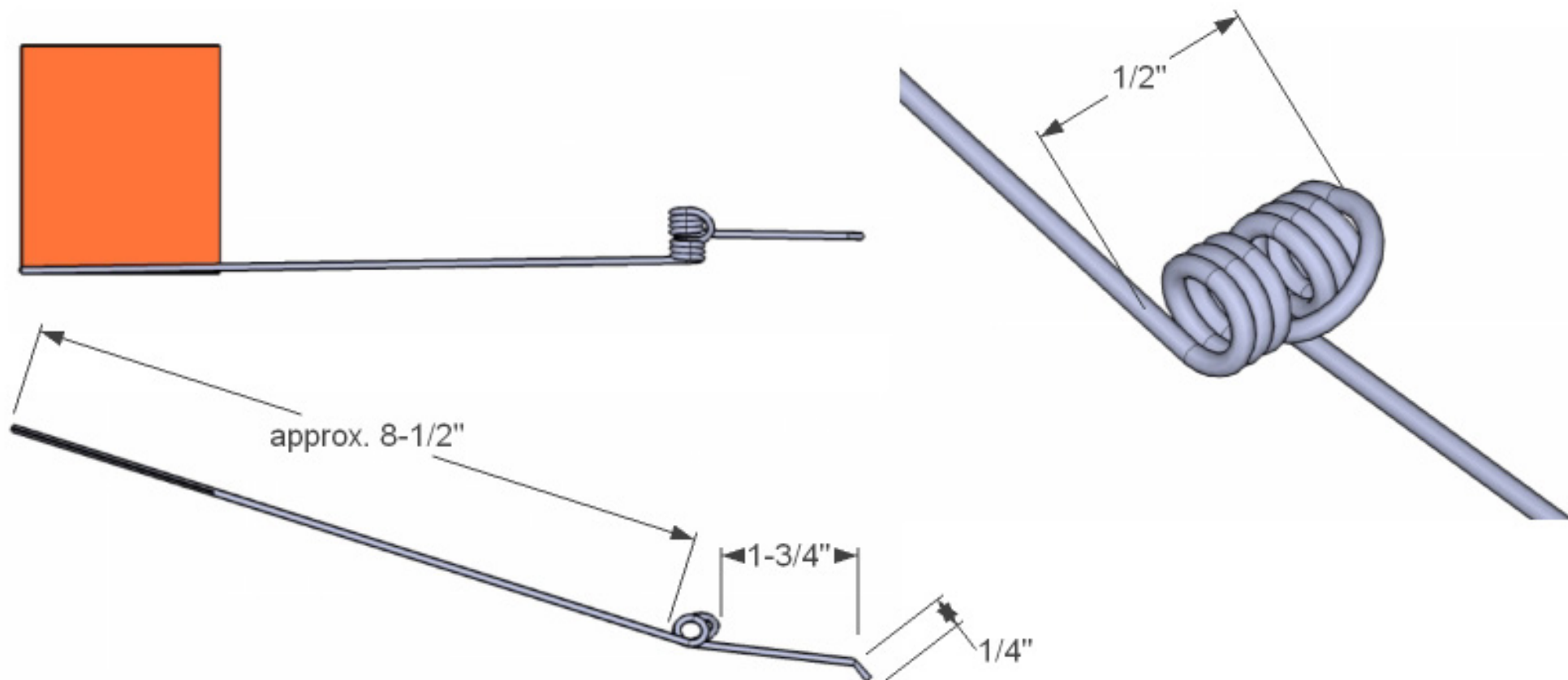
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sheet 4 of 4



Instructions (twelve required for final floor assembly):

Begin with a marking flag (21" wire staff, 16 Ga). Acquire a #2 Phillips screwdriver with round shaft (approx. 1/4" dia.) to use as a wrapping core.

1. Coil the wire around the screwdriver shaft as shown on sheet 2 starting 5" from non-flag end and wrapping the flag end CCW around screwdriver.
2. Slide the coil off the screwdriver, flip it over, and slide it back on.
3. Continue the coil, now wrapping clockwise.
4. Complete 3 full wraps.
5. Cut the non-flag end of the wire to 2" long.
6. Bend the last 1/4" of the wire to approx. 60 degrees to avoid subjecting gamepieces to the sharp edge.
7. Gently squeeze coil with pliers to achieve to eliminate gaps between the coils.

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Title:

Storage: Flag

Dwg. No.

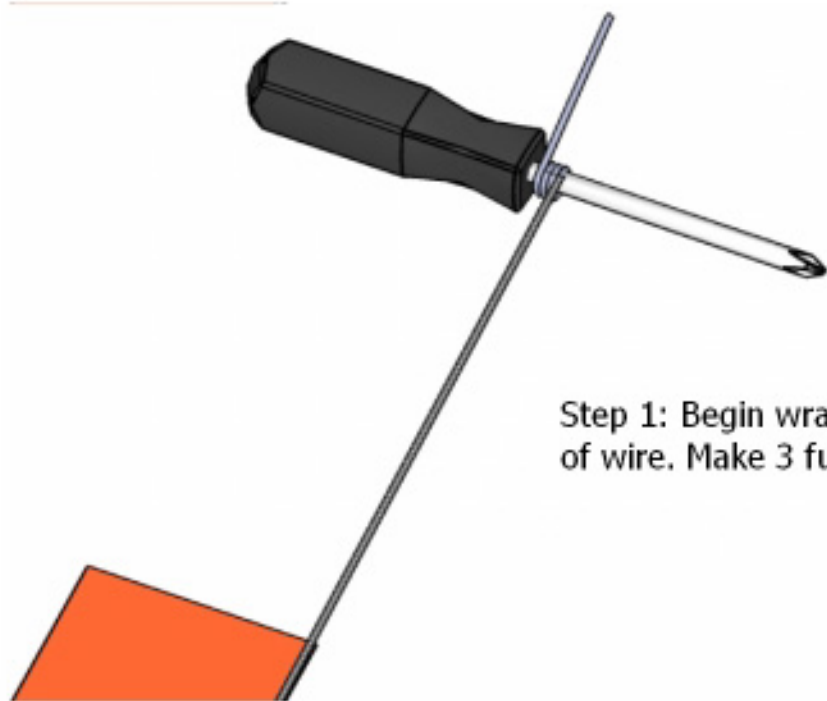
2009S-50

Rev

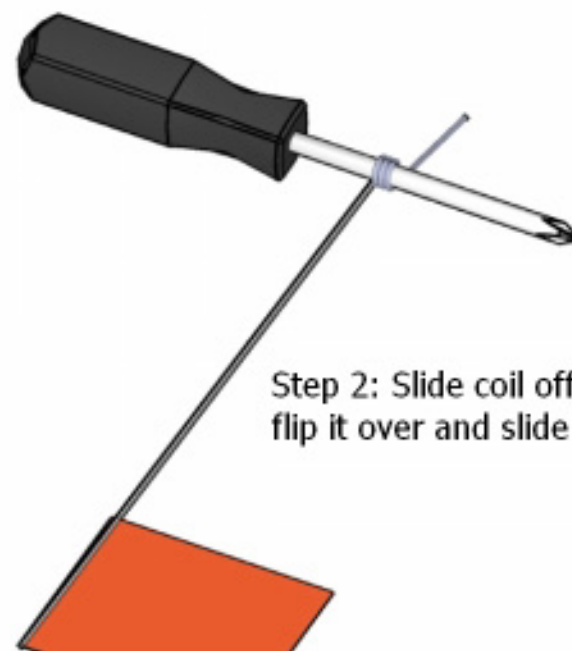
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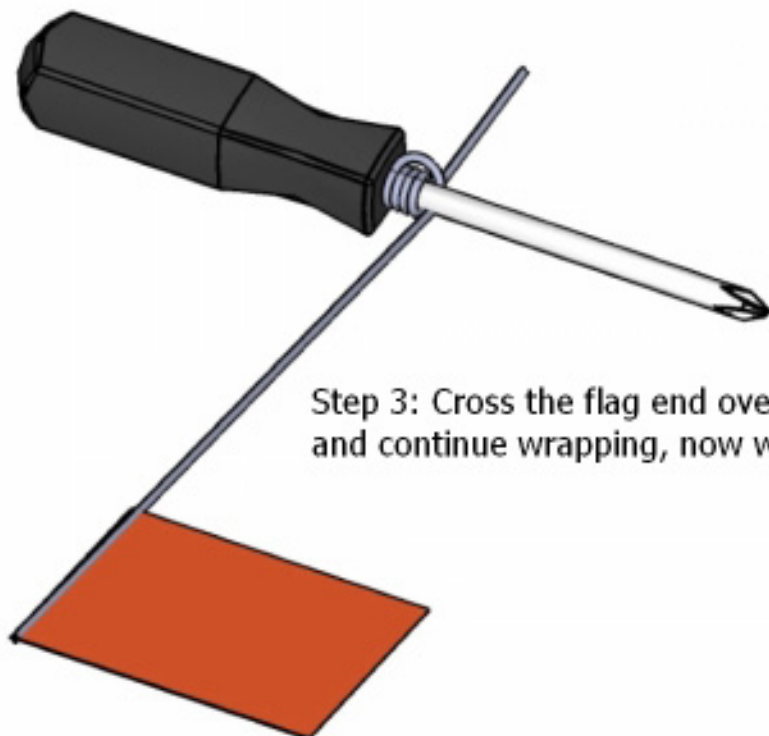
sheet 1 of 2



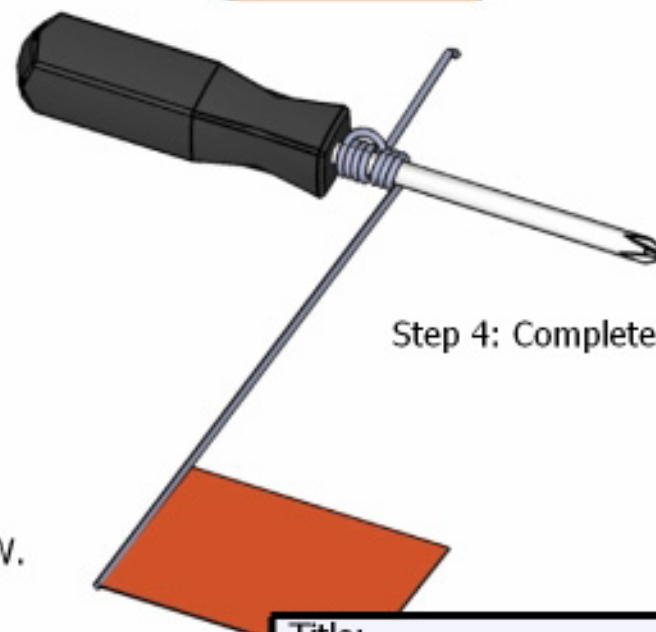
Step 1: Begin wrapping 5" from end of wire. Make 3 full wraps CCW.



Step 2: Slide coil off screwdriver and flip it over and slide it back on.



Step 3: Cross the flag end over the coils and continue wrapping, now wrapping CW.



Step 4: Complete 3 full wraps CW.

Title:

Storage: Flag

Dwg. No.

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sheet 2 of 2